Z+ Series

Programmable DC Power Supplies
200W/400W/600W/800W in 2U
Built-in USB, RS-232 & RS-485 Interface

Optional Interface:
LXI Compliant LAN
IEEE488.2 SCPI (GPIB) Multi-Drop
Isolated Analog Programming

User Manual

TDK·Lambda

Programmable DC Power Supplies

200W/400W

Built-in USB, RS-232 & RS-485 Interface

USER MANUAL

This Manual Covers Models:

Z10-20	**Z20-10**	**Z36-6**	**Z60-3.5**	**Z100-2**
Z10-40	**Z20-20**	**Z36-12**	**Z60-7**	**Z100-4**

IA710-04-01A

Information Concerning Inclusion of Toxic and Hazardous Substances

This information sheet was prepared based on People's Republic of China "Management Methods for Controlling Pollution Caused by Electronic Information Products Regulation"and "SJ/T 11364—2006 Marking for Control of Pollution Caused by Electronic Information Products".
As People's Republic of China "Management Methods for Controlling Pollution Caused by Electronic Information Products Regulation" is a different legislation from EU RoHS Directive (2002/95/EC), inquiries concerning EU RoHS Directive (2002/95/EC) information should be done separately.

		Date of manufacture	
Part Name	Z^+ Series: Z200 & Z400 POWER SUPPLY	Product Weight	Z200: 1.9Kg
		Product Weight	Z400: 1.9Kg

	Concentration Values of Toxic and Hazardous Substances/Elements (wt%)						Notes
	Lead (Pb) 0.1wt%	Mercury (Hg) 0.1wt%	Cadmium (Cd) 0.1wt%	Hexavalent Chromium (Cr6+) 0.1wt%	Polybrominated Biphenyls (PBB) 0.1wt%	Polybrominated Diphenyl Ethers (PBDE) 0.1wt%	
Case	O	O	O	O	O	O	
Plastic panel	O	O	O	O	O	O	
PCB's assembly	X	O	O	O	O	O	
Inner metal parts	O	O	O	O	O	O	
Inner cables	O	O	O	O	O	O	
Accessories	O	O	O	O	O	O	Provided in the package

O : Indicates that the concentration values of toxic and hazardous substances in all "homogeneous materials" of respective parts and materials does not exceed the concentration limits regulated by "SJ/T 11363-2006 Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products".
X : Indicates that the concentration value of a toxic or hazardous substance included in a "homogeneous part" of a respective part or material exceeds the concentration limit regulated by "SJ/T 11363-2006 Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products".

TDK·Lambda

DECLARATION OF CONFORMITY
Z200 and Z400 SERIES

We, TDK-Lambda Ltd., of Industrial Zone P.O.B. 500 Karmiel, Israel, declare under our sole responsibility that the Z200 and Z400 series as detailed on the attached products covered sheet, comply with the provisions of the following European Directives and are eligible to bear the CE mark:

Low Voltage Directive	2006/95/EC
EMC Directive	2004/108/EC

Assurance of conformance of the described product with the provisions of the stated EC Directive is given through compliance to the following standards:

Electrical Safety	EN 61010-1:2001 (2nd Edition)
Electromagnetic Compatibility (EMC):	EN61326-1: 2006

Our European Representative in the EU is TDK-Lambda UK Limited, located at Kingsley Avenue, Ilfracombe, Devon, EX34 8ES UK.

Name of Authorized Signatory	Adam Rawicz-Szczerbo
Signature of Authorized Signatory	
Position of Authorized Signatory	European Managing Director
Date	22nd March 2012
Date Series first CE marked	22nd March 2012
Place where signed	Ilfracombe, Devon, England

TDK·Lambda

PRODUCTS COVERED SHEET FOR:

Z200 series

Z400 series

Model differences for Z400 series and Z200 series model code:

Zxxx-yyy-o-p

Where:

xxx = maximum output voltage, may be any between 10 and 100

yyy = maximum output current, may be any between 2 and 40;

o = options, may be one or a combination of the following:

Blank	stand model (without additional modules installed, standard enclosure)
L	lab. Option: output on front side-binding post (wide body enclosure)
IEEE	optional IEEE communications module (wide body enclosure)
IS420	fitted with optional current mode isolated analogue module (wide body enclosure)
IS510	fitted with optional voltage mode isolated analogue module (wide body enclosure)
LAN	optional LAN communications module (standard and wide body enclosure)

P = optional power cord set provided with unit, may be one of the following:

Blank	power cord set not provided with unit
E	power cord set for Europe
I	power cord set for Israel
U	power cord set for USA/Canada

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WARRANTY

This TDK-Lambda product is warranted against defects in materials and workmanship for a period of five years from date of shipment. During the warranty period, TDK-Lambda will, at it's option, either repair or replace products which prove to be defective.

Limitation of Warranty

The warranty shall not apply to defects resulting from improper or inadequate usage or maintenance by the buyer, buyer supplied products or interfacing. The warranty shall not apply to defects resulting from unauthorized modifications or from operation exceeding the environmental specifications of the product or if the QA seal has been removed or altered by anyone other than TDK-Lambda authorised personnel. TDK-Lambda does not warrant the buyers circuitry or malfunctions of TDK-Lambda products resulting from the buyer's circuitry. Furthermore, TDK-Lambda does not warrant any damage occurring as a result of the buyer's circuitry or the buyer's supplied products. No other warranty is expressed or implied.

Warranty Service

This product must be returned to an authorized TDK-Lambda service facility for repairs or other warranty service. For products returned to TDK-Lambda for warranty service, the buyer shall prepay shipping charges to TDK-Lambda and TDK-Lambda shall pay the shipping charges to return the product to the buyer. Refer to section 3.11 for Repackaging for Shipment.

Disclaimer

The information contained in this document is subject to change without notice. TDK-Lambda shall not be liable for errors contained in this document or for incidental or consequential damages in connection with the furnishing, performance or use of this material. No part of this document may be photocopied, reproduced or translated into another language without the prior written consent of TDK-Lambda.

Trademark Information

Z^{+} power supply is a trademark of TDK-Lambda, Microsoft™ and Windows™ are trademarks of Microsoft Corporation.

REGULATORY NOTICES

FCC Notice

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

WARNING:

Modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment under FCC Rules.

CE NOTICE (European Union)

Marking by the CE Symbol indicates compliance to the Low Voltage Directive (2006/95/EC) of the European Union. Such marking is indicative that the Z^+ series meet the following technical standard: EN 601010-1 - "Electrical Equipment For Measurement, Control and Laboratory Use; Part 1: General Requirements." A "Declaration of Conformity" in accordance with the preceding directives and standards has been made and is on file at our EU representative TDK-Lambda UK, located at Kingsley Avenue, Ilfracombe, Devon EX34 8ES, UK.

SAFETY APPROVALS

UL 61010-1 and CSA-C22.2 No. 61010-1 - UL Listed, C-UL for Canada, IEC/EN 61010-1 - CB/TUV GS. CE marking, when applied to the Z^+ series, indicates compliance with the Low Voltage Directive 2006/95/EC in that it complies with EN 61010-1.

OTHER

Z200 and Z400 series are comply with the following Directives:

- RoHS Directive (2002/95/EC);
- WEEE Directive (2002/96/EC).

SAFETY INSTRUCTIONS

CAUTION:

The following safety precaution must be observed during all phases of operation, service and repair of this equipment. Failure to comply with the safety precautions or warnings in this document violates safety standards of design, manufacture and intended use of this equipment and may impair the built-in protections within. TDK-Lambda shall not be liable for user's failure to comply with these requirements.

VORSICHT:

Die folgenden Sicherheitsvorschriften müssen vor Inbetriebnahme und in jedem Betriebszustand bei Service oder Reparatur beachtet werden. Missachtung der Sicherheitsvorschriften und Warnhinweise aus diesem Handbuch führen zur Verletzung der bestehenden Sicherheitsstandards. Bei Betrieb des Gerätes außerhalb des bestimmungsgemäßen Einsatzes können die im Gerät integrierten Schutzfunktionen beeinträchtigt werden. TDK-Lambda ist nicht haftbar für Schäden, die durch Missachtung dieser Sicherheitsvorschriften entstehen können.

CAUTION:

Z^+ series units are not authorized for use as critical component in nuclear control systems, life support systems or equipment for use in hazardous environments without the express written approval of the managing director of TDK-Lambda.

VORSICHT:

Die Geräte der Z^+ Serie sind ohne ausdrückliche schriftliche Genehmigung des Geschäftsführers von TDK-Lambda nicht für die Benutzung als kritische Komponente in nuklearen Steuerungssystemen, lebenserhaltenden Systemen oder Geräten für den Einsatz in gefährlichen Umgebungen zugelassen.

OVERVOLTAGE CATEGORY AND ENVIRONMENTAL CONDITIONS

The Z^+ series units have been evaluated to Overvoltage category II.
The Z^+ series units are intended for use in the following operation conditions:
* Indoor use
* Pollution degree 2
* Max. operational altitude: 3000m above sea level
* Ambient temperature: 0°C-50°C.

ÜBERSPANNUNGSKATEGORIE UND UMWELTBEDINGUNGEN

Die Geräte der Z^+ Serie wurden hinsichtlich der Überspannungskategorie II ausgewertet.
Die Geräte der Z^+ Serie sind zur Benutzung unter folgenden Betriebsbedingungen vorgesehen:
* Benutzung in Innenräumen
* Verschmutzungsgrad 2
* Maximale geografische Höhe für den Betrieb: 3000 m über Null
* Umgebungstemperatur: 0 °C – 50 °C.

GROUNDING

Z^+ series units are Class I product. To minimize electrical shock hazard, the Z^+ series units must be connected to an electrical ground. The instruments must be connected to the AC power supply mains through a standard certified three-wire power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective ground conductor or disconnection of the protective earth terminal will cause a potential shock hazard that might cause personal injury.

ERDUNG

Geräte der Z^+ Serie sind Produkte der Klasse I. Zur Minimierung der Stromschlaggefahr müssen die Geräte der Z^+ Serie an eine elektrische Erdung angeschlossen werden. Die Geräte müssen über ein standardmäßiges, zugelassenes dreiadriges Stromkabel an den Netzstrom angeschlossen werden, wobei der Erdungsdraht fest mit einer Erdungsleitung im Wandstecker verbunden sein muss. Jede Unterbrechung der Erdungsleitung oder Ablösung des Erdungsanschlusses stellt eine potenzielle Stromschlaggefahr her, die zu Körperverletzung führen kann.

LIVE CIRCUITS

Operating personnel must not remove the Z^+ series unit cover.
No internal adjustment or component replacement is allowed by non-TDK-Lambda qualified service personnel. Never replace components with power cable connected. To avoid injuries, always disconnect power, discharge circuits and remove external voltage sources before touching components.

SPANNUNGSFÜHRENDE SCHALTUNGEN

Das Gehäuse von Geräten der Z^+ Reihe darf nicht vom Betriebspersonal geöffnet werden. Änderungen des Innenaufbaus sowie der Austausch von Bauteilen ist ausschließlich qualifizierten Mitarbeitern der TDK-Lambda erlaubt. Vor dem Austausch von Bauteilen ist das Netzkabel bzw. die Versorgungsspannung zu trennen. Zur Vermeidung von Körperverletzung sind vor der Berührung von Bauteilen stets die Stromanschlüsse zu trennen, Schaltungen zu entladen und Fremdspannungsquellen zu entfernen.

PARTS SUBSTITUTIONS & MODIFICATIONS

Parts substitutions and modifications are by authorized TDK-Lambda service personnel only. For repairs or modifications, the instrument must be returned to TDK-Lambda service facility.

AUSWECHSELN UND VERÄNDERUNG VON BAUTEILEN

Das Auswechseln sowie die Veränderung von Teilen darf nur von zugelassenen TDK-Lambda Servicemitarbeitern durchgeführt werden. Für Reparaturen oder Veränderungen muss das Gerät an den TDK-Lambda Kundendienst zurückgeschickt werden.

AC INPUT

Do not connect Z^+ series unit to mains supply exceeding the input voltage and frequency rating. The input voltage and frequency rating is: 100-240V~, 50/60Hz. For safety reasons, the mains supply voltage fluctuations should not exceed +/-10% of nominal voltage.

NETZSTROMEINGANG

Geräte der Z^+ Serie nicht an einen Netzanschluss anschließen, dessen Eingangsspannung und Frequenz über die Gerätewerte hinausgehen. Eingangsspannung und Frequenz betragen: 100-240 V~ 50/60 Hz. Für sicheren Betrieb des Gerätes ist eine Abweichung von maximal +/-10 % von der Nominalspannung erlaubt.

ENERGY HAZARD

The main output of Z^+ series units is capable of providing hazardous energy. Due to hazardous energy level the output and connections therefore must not be user accessible. Manufacturer's final equipment must provide protection to service personnel against inadvertent contact with output bus bars.

GEFÄHRLICHE ENERGIELEISTUNG

Der Hauptausgang der Geräte der Z^+ Serie könnte gefährliche Energiestufen erzeugen. Auf Grund der gefährlichen Energiestufe dürfen der Ausgang und die Verbindungen nicht für Benutzer zugänglich sein. Die Endgeräte des Herstellers müssen den Schutz des Bedienungspersonals gegen versehentlichen Kontakt mit Ausgangsstromschienen gewährleisten.

FUSE

Internal fuse is sized for fault protection and if a fuse was opened it would indicate that service is required. Fuse replacement should be made by qualified technical personnel.
Refer to maintenance instructions in Chapter 11 for fuse ratings.

WARNING:

There is a potential shock hazard when using a power supply with a rated output voltage greater than 70V. Do not turn ON power supply with rated output voltage above 70VDC without output bus-bars or output connector protection assembled. Turn OFF power supply or disconnect power supply from AC mains before making or changing any rear panel connection.

WARNUNG:

Beim Einsatz eines Netzteils mit einer Nenn-Ausgangsspannung von mehr als 70 V besteht Stromschlaggefahr. Schalten Sie ein Netzteil mit einer Nenn-Ausgangsspannung von über 70 VDC nicht EIN, wenn Sammelschienen oder Ausgangsschutz nicht montiert sind. Bevor ein Anschluss an der Geräterückseite erstellt oder verändert wird, schalten Sie die Stromversorgung AUS oder trennen Sie das Netzteil vom Netzstrom.

SICHERUNG

Die innen befindliche Sicherung ist als Fehlerschutz angepasst. Wurde eine Sicherung geöffnet weist dies auf die Notwendigkeit der Wartung hin. Die Sicherung darf nur durch qualifizierte technische Fachkräfte ausgetauscht werden.
Die Stäkre der Sicherungen entnehmen Sie der Wartungsanleitung in Kapitel 11.

MASCHINENLAERM

Maschinenlaerm informations - Verordnung - 3. GPSGV, der hoechste Schalldruckpegel betraegt 70 dB(A) oderweniger gemass EN ISO7779.

SYMBOLS

	Caution, risk of danger. Instruction manual symbol. The instrument will be marked with this symbol when it is necessary for the user to refer to the instruction manual. Achtung Gefahr. Symbol im Benutzerhandbuchs Das Gerät wird mit diesem Symbol gekennzeichnet, wenn sich der Benutzer auf die Anweisungen im Handbuch beziehen muss.
	Indicates ground terminal. Zeigt einen Erdungsanschluss an.
	Protective Conductor Terminal. Schutzleiterklemme.
	ON (Supply). EIN (Zufuhr).
	OFF (Supply). AUS (Zufuhr).
	Standby (Supply) . Standby (Zufuhr) .
	Direct current (DC). Gleichstrom (DC).
	Alternate current (AC). Wechselstrom (AC).
WARNING	Denotes hazard. An attention to a procedure is called. Not following the procedure correctly could result in personal injury. A WARNING sign should not be skipped and all indicated conditions must be fully understood and met. Bezeichnet Gefahren. Es wird die Beachtung eines Verfahrens empfohlen. Nichteinhaltung des Verfahrens kann zu Körperverletzung führen. Ein WARN-Hinweis darf nicht ignoriert und alle angeführten Verfahren müssen eindeutig verstanden und umgesetzt werden.
CAUTION	Denotes hazard. An attention to a procedure is called. Not following the procedure correctly could result in damage to the equipment. Bezeichnet Gefahren. Es wird die Beachtung eines Verfahrens empfohlen. Mangelhafte Einhaltung des Verfahrens kann zu Beschädigung der Geräte führen.

CHAPTER 1: GENERAL INFORMATION

1.1 User Manual Content

This user's manual contains the operating instructions, installation instructions and specifications of the Z+ Series 200W and 400W power supply series. The instructions refer to the standard power supplies, including the built-in USB and RS232/485 serial communication. For information related to operation with the optional LAN and IEEE, refer to User Manual for power supply LAN and IEEE.

1.2 Introduction

1.2.1 General Description

Z+ Series power supplies are wide output range, high performance switching power supplies. The Z+ Series is power factor corrected and operates from worldwide AC voltage range continuously. Output voltage and current are continuously displayed and LED indicators show the complete operating status of the power supply. The Front Panel controls allow the user to set the output parameters, the protection levels (Over-Voltage protection, Under-Voltage protection and Foldback) and preview the settings. The rear panel includes the necessary connectors to control and monitor the power supply operation by remote analog signals or by the built-in serial communication USB and RS232/485. LAN, IEEE and Isolated-Analog programming/monitoring are optional.

1.2.2 Models Covered by this Manual

Model	Voltage range (V)	Current range (A)
Z10-20	0-10	0-20
Z10-40	0-10	0-40
Z20-10	0-20	0-10
Z20-20	0-20	0-20
Z36-6	0-36	0-6
Z36-12	0-36	0-12
Z60-3.5	0-60	0-3.5
Z60-7	0-60	0-7
Z100-2	0-100	0-2
Z100-4	0-100	0-4

1.2.3 Features and Options

- Constant Voltage / Constant Current with automatic crossover.
- Active Power Factor correction.
- Universal Input Voltage 85-265Vac, continuous operation.
- Embedded Microprocessor Controller.
- Built in USB & RS232/485 Interface.
- Voltage & Current high resolution adjustment by digital Encoders.
- High resolution 16 bit ADCs & DACs.
- Software Calibration (no internal trimmers / potentiometers).
- Last Setting Memory.
- Independent Remote ON/OFF (Opto-Isolated) and Remote Enable/Disable.
- Parallel operation (Master/Slave) with Active current sharing.
- Remote sensing to compensate for voltage drop of power leads.
- External Analog Programming and Monitoring (0-5V or 0-10V, user selectable).
- Cooling fan speed control for low noise and extended fan life.
- Optional LAN interface (SCPI compatible).
- Optional IEEE interface (SCPI compatible).
- Optional Isolated Analog programming/monitoring (0-5V or 0-10V, user selectable and 4-20mA).

1.2.4 Multiple Output Power System

The Z^+ Series power supplies series can be configured into a programmable power system of up to 31 units using the built-in USB or RS232/RS485 communication port in the power supply and the RS485 linking cable provided with each power supply.
In a LAN system, each power supply can be controlled using the optional LAN controller (factory installed). In an IEEE system, each power supply can be controlled using the optional IEEE controller (factory installed).

1.2.5 Control via the USB or RS232/485 Communication Ports

The following parameters can be programmed via the serial communication port:

- Output voltage setting.
- Output current setting.
- Output voltage measurement.
- Output current measurement.
- Output on/off control.
- Foldback protection setting.
- Over-voltage protection setting and readback.
- Under-Voltage protection setting and readback.
- Under-Voltage limit setting and read back.
- Power-supply start up mode (last setting or safe mode).

1.2.6 Analog Voltage Programming and Monitoring

Analog inputs and outputs are provided at the rear panel for analog control of the power supply. The output voltage and the current limit can be programmed by analog voltage or by resistor, and can be monitored by analog voltage. The power supply output can be remotely set to On or Off and analog signals monitor the proper operation of the power supply and the mode of operation (CV/CC).

1.2.7 Parallel Operation

Up to six Z^+ Series power supplies of the same output voltage and current rating can be paralleled in master-slave configuration with automatic current sharing to increase available power.

1.2.8 Output Connections

Output connections are made to rear panel bus-bars. Either the positive or negative terminal may be grounded or the output may be floated. Models up to 100VDC rated output shall not float outputs more than +/- 100VDC above/below chassis ground. Contact factory for assistance with higher float voltage applications.
Local or remote sense may be used. In remote sense, the voltage drop on the load wires should be minimized. Refer to the specifications for the maximum voltage drop value.

1.2.9 Cooling and Mechanical Construction

The Z^+ Series is cooled by an internal fan. At installation, care must be taken to allow free air flow into the power supply via the front panel, and out of the power supply via the rear panel. The Z^+ Series power supply is a compact and lightweight unit which allows for easy installation and gives a space saving solution for customer applications.

CAUTION:

Observe all torque guidelines within this manual. Over torque may damage unit or accessories. Such damage is not covered under manufacturers warranty.

1.3 Accessories

1.3.1 General

Accessories are delivered with the power supply or separately upon ordering, The list below shows the possible accessories and ordering numbers.

1.3.2 Serial Link Cable

Serial link cable, for linking power supplies by RS485 communication is provided with the power supply.
Cable description: 0.5m length, shielded, RJ-45 type plugs, 8 contacts (P/N: GEN/RJ45).

1.3.3 Misc. Hardware

- Bus bars protection
- Connector protection
- Connector housing IPD1-06-D-K(SAMTEC)
- Connector housing IPD1-04-D-K(SAMTEC)
- Connector housing IPD1-02-D-K(SAMTEC)
- Contact pins P/N: CC79R-2024-01-L(SAMTEC)

1.3.4 AC Cables

AC cables are not provided with the power supply. If an AC cable is required, it should be ordered according to the following:

Part no.	Market	Description
Z-U	USA	13A 125V, non shielded, 2m typical length, with IEC60320-1, type C15 connector on one end and NEMA-5-15P type plug on the other end.
Z-E	Europe	10A 250V, non shielded, 2m typical length, with IEC60320-1, type C15 connector on one end and IEC60884-1 type plug on the other end.
Z-J	Japan	15A 125V, non shielded, 2m typical length, with IEC60320-1, type C15 connector on one end and Japan JIS C8303 type plug on the other end.
Z-GB	UK	10A 250V non shielded, 2m typical length, with IEC60320-1, type C15 connector on one end and UK BS 1363 type plug on the other end.
Z-O	GENERAL	10A 250V, non shielded, 2m typical length, with IEC60320-1, type C15 connector on one end and non-terminated stripped wires on the other end. Use the cable only with plug approved by the national safety standards of the country of usage.

1.3.5 Serial Port Cables

If a serial port cable is required, it should be ordered according to the description in section 7.2
* USB cables are not provided with the power supply.

CHAPTER 2: SPECIFICATIONS

2.1 Z+200 SERIES SPECIFICATIONS

MODEL	Z	10-20	20-10	36-6	60-3.5	100-2
1. Rated output voltage(*1)	V	10	20	36	60	100
2. Rated output current (*2)	A	20	10	6	3.5	2
3. Rated output power	W	200	200	216	210	200

CONSTANT VOLTAGE MODE		V	10-20	20-10	36-6	60-3.5	100-2
1. Max. Line regulation (*6)		---	0.01% of rated output voltage+2mV				
2. Max. Load regulation (*7)		---	0.01% of rated output voltage+2mV				
3. Ripple and noise (p-p, 20MHz) (*8)		mV	50	50	50	50	80
4. Ripple r.m.s. 5Hz~1MHz		mV	5	6	6	7	8
5. Temperature coefficient		PPM/°C	30PPM/°C from rated output voltage, following 30 minutes warm-up.				
6. Temperature stability		---	0.02% of rated Vout over 8hrs. interval following 30 minutes warm-up. Constant line, load & temp.				
7. Warm-up drift		---	Less than 0.05% of rated output voltage+2mV over 30 minutes following power on.				
8. Remote sense compensation/wire		V	1	1	2	3	5
9. Up-prog. Response time, 0~Vomax.(*9)		mS	15	30	30	50	50
10. Down-prog.response time:	Full load (*9)	mS	10	25	30	40	50
	Time delay (*17)		210	250	320	380	1200
	No load (*10) (*15)(*17)		40	65	85	100	250
	No load (*10) (*16)(*17)		200	200	290	310	1100
11. Transient response time		mS	Time for output voltage to recover within 0.5% of its rated output for a load change 10~90% of rated output current. Output set-point: 10~100%, Local sense Less than 1mS, for models up to and including 100V				
12. Hold-up time (*19)		---	15mSec Typical.	16mSec Typical. wRated output power			

CONSTANT CURRENT MODE	V	10-20	20-10	36-6	60-3.5	100-2
1. Max. Line regulation (*6)	---	0.01% of rated output current+2mA				
2. Max. Load regulation (*11)	---	0.01% of rated output current+5mA				
3. Load regulation thermal drift	---	Less than 0.05% of rated output current over 30 minutes following load change.				
4. Ripple r.m.s. 5Hz~1MHz (*12)	mA	25	15	8	4	3
5. Temperature coefficient	PPM/°C	100PPM/°C from rated output current, following 30 minutes warm-up.				
6. Temperature stability	---	0.05% of rated Iout over 8hrs. interval following 30 minutes warm-up. Constant line, load & temperature.				
7. Warm-up drift	---	Less than +/-0.1% of rated output current over 30 minutes following power on.				

PROTECTIVE FUNCTIONS	V	10-20	20-10	36-6	60-3.5	100-2
1. Foldback protection	---	Output shut-down when power supply change mode from CV to CC or CC to CV. User presetable. Reset by AC input recycle in autostart mode or by OUT button or by rear panel ENABLE, or by communication port.				
2. Over-voltage protection (OVP)	---	Inverter Shut down method. Reset by AC input recycle in autostart mode or by OUT button or by rear panel ENABLE, or by communication port.				
3. Over -voltage trip point	V	0.5-12	1~24	2~40	5~66	5~110
4. Output under voltage limit (UVL)	---	Preset by front panel or communication port. Prevents from adjusting Vout below limit. Does not affect in analog programming.				
5. Output under voltage protection (UVP)	---	Output shut-down when power supply output voltage goes below UVP programming. User presetable. Reset by AC input recycle in autostart mode or by OUT button or by rear panel ENABLE, or by communication port.				
6. Over temperature protection	---	User selectable, latched or non latched.				

ANALOG PROGRAMMING AND MONITORING		
1. Vout voltage programming	---	0~100%, 0~5V or 0~10V, user selectable. Accuracy and linearity: +/-0.5% of rated Vout.
2. Iout voltage programming (*13)	---	0~100%, 0~5V or 0~10V, user selectable. Accuracy and linearity: +/-1% of rated Iout.
3. Vout resistor programming	---	0~100%, 0~5/10Kohm full scale, user selectable. Accuracy and linearity: +/-1% of rated Vout.
4. Iout resistor programming (*13)	---	0~100%, 0~5/10Kohm full scale, user selectable. Accuracy and linearity: +/-1.5% of rated Iout.
5. Shut Off (SO) control	---	By electrical Voltage: 0~0.6V/2~15V or dry contact, user selectable logic.
6. Output current monitor (*13)	---	0~5V or 0~10V, user selectable. Accuracy: +/-1%.
7. Output voltage monitor	---	0~5V or 0~10V, user selectable. Accuracy: +/-1%.
8. Power supply OK signal	---	4~5V-OK, 0V-Fail. 500ohm series resistance.
9. Parallel operation	---	Possible, up to 6 units in master/slave mode with single wire current balance connection.
10. Series operation	---	2 identical units (with external diodes).
11. CV/CC indicator	---	Open collector. CC mode: On, CV mode: Off. Maximum voltage: 30V, maximum sink current: 10mA
12. Interlock (ILC) control	---	Enables/Disables the PS output by dry contact (Short: On, Open: Off, Source current: less than 0.5mA). Ena/Dis is activated by front panel.
13. Local/Remote mode Control	---	By electrical signal or Open/Short: 0~0.6V or short: Remote, 2~15V or open: Local
14. Local/Remote mode Indicator	---	Open collector (shunted by 36V zener). On (0~0.6V, 10mA sink current max.)-Remote. Off-Local (30V max.).
15.Trigger out	---	Maximum low level output = 0.8V, Minimum high level output = 2V, maximum source current = 8mA, pulse =20us Typical.
16.Trigger in	---	"Maximum low level input voltage = 0.8V,minimum high level input votage = 2.0V, Maximum sink current = 8mA, possitive edge trigger: tw=10us minimum.
TpLH,TpHL=1us maximum."	---	Open collector, maximum voltage 25V,maximum sink current 100mA. (Shunted by 27V zener)
18. Programmed signal 2	---	Open collector, maximum voltage 25V,maximum sink current 100mA. (Shunted by 27V zener)

FRONT PANEL		
1. Control functions	---	Multiple options with 2 Encoders
	---	Vout/Iout manual adjust
	---	OVP/UVL/UVP manual adjust
	---	Protection Functions - OVP, UVL,UVP, Foldback, OCP, INT, SO
	---	Communication Functions - Selection of LAN,IEEE,RS232,RS485,USB
	---	Communication Functions - Selection of Baud Rate, Address
	---	Analog Control Functions - Selection Voltage/resistive programming, 5V/10V, 5K/10K programming
	---	Analog Control Functions - Selection of Voltage/Current Monitoring 5V/10V, Output ON/OFF, Front Panel Lock.
2. Display	---	Vout: 4 digits, accuracy: 0.5% of rated output voltage+/-1 count.
	---	Iout: 4 digits, accuracy: 0.5% of rated output current+/-1 count.
3. Indications	---	GREEN LED's: FINE, MENU, PREV, PROT, REM/LOC,OUT ON/OFF , CV, CC
	---	RED LED's: ALRM (OVP, UVP,OTP, FOLD, AC FAIL).
4. Function buttons	---	FINE, MENU, PREV, PROT, REM/LOC, OUT ON/OFF

PROGRAMMING AND READBACK (RS232/485,USB, Optional: IEEE, LAN)		
1. Vout programming accuracy	---	0.05% of rated output voltage
2. Iout programming accuracy (*13)	---	0.1% of actual +0.1% of rated output current
3. Vout programming resolution	---	0.012% of full scale
4. Iout programming resolution	---	0.012% of full scale
5. Vout readback accuracy	---	0.05% of rated output voltage
6. Iout readback accuracy (*13)	---	0.1% of actual +0.3% of rated output current
7. Vout readback resolution	---	0.012% of full scale
8. Iout readback resolution	---	0.012% of full scale

Z+200 SERIES SPECIFICATIONS

INPUT CHARACTERISTICS	V	10-20	20-10	36-6	60-3.5	100-2
1. Input voltage/freq. (*3)	---	85~265Vac continuous, 47~63Hz, single phase				
2. Maximum Input current 100/200VAC (*18)	---	2.65/1.30	2.61/1.28	2.71/1.34	2.68/1.32	2.54/1.26
3. Power Factor (Typ)	---	>0.99 at 100Vac, >0.98 at 200Vac,100% load				
4. Efficiency (Typ) 100/200VAC (*4) (*18)	%	76/78	77/79	80/82	79/81	79/81
5. Inrush current (*5)	---	Less than 15A/30A				

ENVIRONMENTAL CONDITIONS		
1. Operating temperature	---	0~50°C, 100% load.
2. Storage temperature	---	-20~85°C
3. Operating humidity	%	20~90% RH (no condensation).
4. Storage humidity	%	10~95% RH (no condensation).
5. Altitude	---	Maximum 3000m. Derate ambient temp above 2000m. Operating: Maximum ambient temperature, From 2000m up to 3000m Ambient temperature 40°C.

SAFETY/EMC			
1. Applicable standards:	Safety	---	UL61010-1, EN61010-1, IEC61010-1. Design to meet UL60950-1, EN60950-1 10V≤Vout≤60V: Output,J1,J2,J3,J4,USB,LAN,IEEE/ISOLATED Analog are Non Hazardous Vout=100V:Output,J1,J2 are Hazardous J3,J4,USB, IEEE/ISOLATED Analog ,LAN are Non Hazardous
	EMC	---	IEC61326-1 (Built to meet EN55022/EN55024)
2. Withstand voltage		---	10≤Vout≤36V models: Input-Output&J1,J2,J3,J4,USB,LAN/IEEE/ISOLATED ANALOG: 4242VDC/1min; Input-Ground: 2828VDC/1min. Output&J1,J2,J3,J4,USB,LAN/IEEE/ISOLATED ANALOG-Ground: 1000VDC/1min. 60V,100V models: Input-Output&J1,J2: 4242VDC/1min; Input-J3,J4,USB,LAN/IEEE/ISOLATED Analog: 4242VDC/1min; Input-Ground: 2828VDC/1min. Output&J1,J2- J3,J4,USB,LAN/IEEE/ISOLATED ANALOG :1910VDC/1min; Output&J1,J2-Ground: 1380VDC/1min. J3, J4, USB/LAN/IEEE/ISOLATED ANALOG - Ground: 1000VDC/1min;
3. Insulation resistance		---	More than 100Mohm at 25°C, 70%RH.
4. Conducted emission		---	EN55022B, FCC part 15-B, VCCI-B
5. Radiated emission		---	EN55022B, FCC part 15-B, VCCI-B

MECHANICAL			
1. Cooling		---	Forced air cooling by internal fan.
2. Weight	STANDARD	Kg	Less than 1.9Kg.
	WIDE BODY	Kg	Less than 2.4Kg. Wide body with Isolated analog or Binding post or IEEE.
3. Dimensions (WxHxD)	STANDARD	mm	H: 83, W: 70, D: 350 (excluding bus bars, handles…). (Refer to Outline drawing).
	WIDE BODY	mm	H: 83, W: 105, D: 350 (excluding bus bars, handles…). (Refer to Outline drawing).
4. Vibration		---	According to: IEC60068-2-64
5. Shock		---	Less than 20G, half sine, 11mS. Unit is unpacked. According to: IEC600068-2-27

NOTES:
*1: Minimum voltage is guaranteed to maximum 0.1% of rated output voltage.
*2: Minimum current is guaranteed to maximum 0.2% of rated output current.
*3: For cases where conformance to various safety standards (UL, IEC, etc…) is required, to be described as 100-240Vac (50/60Hz).
*4: Ta=25°C with rated output power.
*5: Not including EMI filter inrush current, less than 0.2mSec at cold start Ta=25°C
*6: At 85~132Vac or 170~265VAC, constant load.
*7: From No-Load to Full-Load, constant input voltage. Measured at the sensing point in Remote Sense.
*8: Measured with JEITA RC-9131A (1:1) probe.
*9: From 10% to 90% or 90% to 10% of Rated Output Voltage, with rated resistive load.
*10: From 90% to 10% of Rated Output Voltage.
*11: For load voltage change, equal to the unit voltage rating, constant input voltage.
*12: For 10V model the ripple is measured at 2V to rated output voltage and rated output current. For other models, the ripple is measured at 10~100% of rated output voltage and rated output current.
*13: The Constant Current programming, readback and monitoring accuracy do not include the warm-up and Load regulation thermal drift.
*14: Measured with JEITA RC-9131A (1:1) probe.
*15: For cases where the time interval between each down programming is longer than Td (time delay).
*16: For cases where the time interval between each down programming is shorter than Td (time delay).
*17: Td typical (±20%) Minimum time between consecutive down programming cycles.
*18: PS with isolated analog option decreases efficiency by 1.5% and increases input current by 1.5%
*19: At rated output power.
*20: For Parallel operation more than 2 units 5% of toatal output current is requierd.

2.2 Z+400 SERIES SPECIFICATIONS

MODEL	Z	10-40	20-20	36-12	60-7	100-4
1. Rated output voltage(*1)	V	10	20	36	60	100
2. Rated output current (*2)	A	40	20	12	7	4
3. Rated output power	W	400	400	432	420	400

CONSTANT VOLTAGE MODE	V	10-40	20-20	36-12	60-7	100-4
1. Max. Line regulation (*6)	---	0.01% of rated output voltage+2mV				
2. Max. Load regulation (*7)	---	0.01% of rated output voltage+2mV				
3. Ripple and noise (p-p, 20MHz) (*8)	mV	50	50	50	50	80
4. Ripple r.m.s. 5Hz~1MHz	mV	5	6	6	7	8
5. Temperature coefficient	PPM/°C	30PPM/°C from rated output voltage, following 30 minutes warm-up.				
6. Temperature stability	---	0.02% of rated Vout over 8hrs. interval following 30 minutes warm-up. Constant line, load & temp.				
7. Warm-up drift	---	Less than 0.05% of rated output voltage+2mV over 30 minutes following power on.				
8. Remote sense compensation/wire	V	1	1	2	3	5
9. Up-prog. Response time, 0~Vomax.(*9)	mS	15	30	30	50	50
10. Down-prog.response time: Full load (*9)	mS	10	10	15	30	50
Time delay (*17)		210	250	320	380	1200
No load (*10) (*15) (*17)		40	65	85	100	250
No load (*10) (*16) (*17)		200	200	290	310	1100
11. Transient response time	mS	Time for output voltage to recover within 0.5% of its rated output for a load change 10~90% of rated output current. Output set-point: 10~100%, Local sense. Less than 1mS, for models up to and including 100V				
12. Hold-up time (*19)	---	15mSec Typical.	16mSec Typical. Rated output power.			

CONSTANT CURRENT MODE	V	10-40	20-20	36-12	60-7	100-4
1. Max. Line regulation (*6)	---	0.01% of rated output current+2mA				
2. Max. Load regulation (*11)	---	0.01% of rated output current+5mA				
3. Load regulation thermal drift	---	Less than 0.05% of rated output current over 30 minutes following load change.				
4. Ripple r.m.s. 5Hz~1MHz (*12)	mA	70	40	15	8	3
5. Temperature coefficient	PPM/°C	100PPM/°C from rated output current, following 30 minutes warm-up.				
6. Temperature stability	---	0.05% of rated Iout over 8hrs. interval following 30 minutes warm-up. Constant line, load & temperature.				
7. Warm-up drift	---	Less than +/-0.1% of rated output current over 30 minutes following power on.				

PROTECTIVE FUNCTIONS	V	10-40	20-20	36-12	60-7	100-4
1. Foldback protection	---	Output shut-down when power supply change mode from CV to CC or CC to CV. User presetable. Reset by AC input recycle in autostart mode or by OUT button or by rear panel ENABLE, or by communication port.				
2. Over-voltage protection (OVP)	---	Inverter Shut down method. Reset by AC input recycle in autostart mode or by OUT button or by rear panel ENABLE, or by communication port.				
3. Over - voltage trip point	V	0.5-12	1~24	2~40	5~66	5~110
4. Output under voltage limit (UVL)	---	Preset by front panel or communication port. Prevents from adjusting Vout below limit. Does not affect in analog programming.				
5. Output under voltage protection (UVP)	---	Output shut-down when power supply output voltage goes below UVP programming. User presetable. Reset by AC input recycle in autostart mode or by OUT button or by rear panel ENABLE, or by communication port.				
6. Over temperature protection	---	User Selectable. Latched or non latched				

ANALOG PROGRAMMING AND MONITORING		
1. Vout voltage programming	---	0~100%, 0~5V or 0~10V, user selectable. Accuracy and linearity: +/-0.5% of rated Vout.
2. Iout voltage programming (*13)	---	0~100%, 0~5V or 0~10V, user selectable. Accuracy and linearity: +/-1% of rated Iout.
3. Vout resistor programming	---	0~100%, 0~5/10Kohm full scale, user selectable. Accuracy and linearity: +/-1% of rated Vout.
4. Iout resistor programming (*13)	---	0~100%, 0~5/10Kohm full scale, user selectable. Accuracy and linearity: +/-1.5% of rated Iout.
5. Shut Off (SO) control	---	By electrical Voltage: 0~0.6V/2~15V or dry contact, user selectable logic.
6. Output current monitor (*13)	---	0~5V or 0~10V, user selectable. Accuracy: +/-1%.
7. Output voltage monitor	---	0~5V or 0~10V, user selectable. Accuracy: +/-1%.
8. Power supply OK signal	---	4~5V-OK, 0V-Fail. 500ohm series resistance.
9. Parallel operation	---	Possible, up to 6 units in master/slave mode with single wire current balance connection.
10. Series operation	---	2 identical units (with external diodes).
11. CV/CC indicator	---	Open collector. CC mode: On, CV mode: Off. Maximum voltage: 30V, maximum sink current: 10mA
12. Interlock (ILC) control	---	Enables/Disables the PS output by dry contact (Short: On, Open: Off, Source current: less than 0.5mA). Ena/Dis is activated by front panel.
13. Local/Remote mode Control	---	By electrical signal or Open/Short: 0~0.6V or short: Remote, 2~15V or open: Local
14. Local/Remote mode Indicator	---	Open collector (shunted by 36V zener). On (0~0.6V, 10mA sink current max.)-Remote. Off-Local (30V max.).
15.Trigger out	---	Maximum low level output = 0.8V, Minimum high level output = 2V, maximum source current = 8mA, pulse =20us Typical.
16.Trigger in	---	"Maximum low level input voltage = 0.8V, minimum high level input votage = 2.0V, Maximum sink current = 8mA, possitive edge trigger: tw=10us minimum.
TpLH,TpHL=1us maximum."	---	Open collector, maximum voltage 25V, maximum sink current 100mA. (Shunted by 27V zener)
18. Programmed signal 2	---	Open collector, maximum voltage 25V, maximum sink current 100mA. (Shunted by 27V zener)

FRONT PANEL		
1. Control functions	---	Multiple options with 2 Encoders
	---	Vout/Iout manual adjust
	---	OVP/UVL /UVP manual adjust
	---	Protection Functions - OVP, UVL, UVP, Foldback, OCP, INT, SO
	---	Communication Functions - Selection of LAN,IEEE,RS232,RS485,USB
	---	Communication Functions - Selection of Baud Rate, Address
	---	Analog Control Functions - Selection Voltage/resistive programming, 5V/10V, 5K/10K programming
	---	Analog Control Functions - Selection of Voltage/Current Monitoring 5V/10V, Output ON/OFF, Front Panel Lock.
2. Display	---	Vout: 4 digits, accuracy: 0.5% of rated output voltage+/-1 count.
	---	Iout: 4 digits, accuracy: 0.5% of rated output current+/-1 count.
3. Indications	---	GREEN LED's: FINE, MENU, PREV, PROT, REM/LOC,OUT ON/OFF , CV, CC
	---	RED LED's: ALRM (OVP,UVP, OTP, FOLD, AC FAIL).
4. Function buttons	---	FINE, MENU, PREV, PROT, REM/LOC, OUT ON/OFF

PROGRAMMING AND READBACK (RS232/485,USB, Optional: IEEE(*20), LAN)		
1. Vout programming accuracy	---	0.05% of rated output voltage
2. Iout programming accuracy (*13)	---	0.1% of actual +0.1% of rated output current
3. Vout programming resolution	---	0.012% of full scale
4. Iout programming resolution	---	0.012% of full scale
5. Vout readback accuracy	---	0.05% of rated output voltage
6. Iout readback accuracy (*13)	---	0.1% of actual +0.3% of rated output current
7. Vout readback resolution	---	0.012% of full scale
8. Iout readback resolution	---	0.012% of full scale

Z+400 SERIES SPECIFICATIONS

INPUT CHARACTERISTICS	V	10-40	20-20	36-12	60-7	100-4
1. Input voltage/freq. (*3)	---	85~265Vac continuous, 47~63Hz, single phase				
2. Maximum Input current 100/200VAC (*18)	---	5.05/2.47	4.98/2.45	5.25/2.57	5.10/2.50	4.80/2.37
3. Power Factor (Typ)	---	0.99 at 100/200Vac, 100% load				
4. Efficiency (Typ) 100/200VAC (*4) (*18)	%	80/82	81/83	83/85	83/85	84/86
5. Inrush current (*5)	---	Less than 25A				

ENVIRONMENTAL CONDITIONS		
1. Operating temperature	---	0~50°C, 100% load.
2. Storage temperature	---	-20~85°C
3. Operating humidity	%	20~90% RH (no condensation).
4. Storage humidity	%	10~95% RH (no condensation).
5. Altitude	---	Maximum 3000m. Derate ambient temp above 2000m. Operating: Maximum ambient temperature, From 2000m up to 3000m Ambient temperature 40°C.

SAFETY/EMC			
1. Applicable standards:	Safety	---	UL61010-1, EN61010-1, IEC61010-1. Design to meet UL60950-1, EN60950-1 10V≤Vout≤60V: Output,J1,J2,J3,J4,USB,LAN,IEEE/ISOLATED Analog are Non Hazardous Vout=100V:Output,J1,J2 are Hazardous J3,J4,USB, IEEE/ISOLATED Analog ,LAN are Non Hazardous
	EMC	---	IEC61326-1 (Built to meet EN55022/EN55024)
2. Withstand voltage		---	10≤Vout≤36V models: Input-Output&J1,J2,J3,J4,USB,LAN/IEEE/ISOLATED ANALOG: 4242VDC/1min; Input-Ground: 2828VDC/1min. Output&J1,J2,J3,J4,USB,LAN/IEEE/ISOLATED ANALOG-Ground: 1000VDC/1min. 60V,100V models: Input-Output&J1,J2: 4242VDC/1min; Input-J3,J4,USB,LAN/IEEE/ISOLATED Analog: 4242VDC/1min; Input-Ground: 2828VDC/1min. Output&J1,J2- J3,J4,USB,LAN/IEEE/ISOLATED ANALOG :1910VDC/1min; Output&J1,J2-Ground: 1380VDC/1min. J3, J4, USB/LAN/IEEE/ISOLATED ANALOG - Ground: 1000VDC/1min;
3. Insulation resistance		---	More than 100Mohm at 25°C, 70%RH.
4. Conducted emission		---	EN55022B, FCC part 15-B, VCCI-B
5. Radiated emission		---	EN55022B, FCC part 15-B, VCCI-B

MECHANICAL			
1. Cooling		---	Forced air cooling by internal fan
2. Weight	STANDARD	Kg	Less than 1.9Kg.
	WIDE BODY	Kg	Less than 2.4Kg. Wide body with Isolated analog or Binding post or IEEE
3. Dimensions (WxHxD)	STANDARD	mm	H: 83, W: 70, D: 350 (excluding bus bars, handles…). (Refer to Outline drawing)
	WIDE BODY	mm	H: 83, W: 105, D: 350 (excluding bus bars, handles…). (Refer to Outline drawing)
4. Vibration		---	According to: IEC60068-2-64
5. Shock		---	Less than 20G, half sine, 11mS. Unit is unpacked. According to: IEC600068-2-27

NOTES:
*1: Minimum voltage is guaranteed to maximum 0.1% of rated output voltage.
*2: Minimum current is guaranteed to maximum 0.2% of rated output current.
*3: For cases where conformance to various safety standards (UL, IEC, etc…) is required, to be described as 100-240Vac (50/60Hz).
*4: Ta=25°C with rated output power.
*5: Not including EMI filter inrush current, less than 0.2mSec.
*6: At 85~132Vac or 170~265VAC, constant load.
*7: From No-Load to Full-Load, constant input voltage. Measured at the sensing point in Remote Sense.
*8: Measured with JEITA RC-9131A (1:1) probe.
*9: From 10% to 90% or 90% to 10% of Rated Output Voltage, with rated resistive load.
*10: From 90% to 10% of Rated Output Voltage.
*11: For load voltage change, equal to the unit voltage rating, constant input voltage.
*12: For 10V model the ripple is measured at 2V to rated output voltage and rated output current. For other models, the ripple is measured at 10~100% of rated output voltage and rated output current.
*13: The Constant Current programming, readback and monitoring accuracy do not include the warm-up and Load regulation thermal drift.
*14: Measured with JEITA RC-9131A (1:1) probe.
*15: For cases where the time interval between each down programming is longer than Td (time delay).
*16: For cases where the time interval between each down programming is shorter than Td (Time delay).
*17: Td typical (±20%) Minimum time between consecutive down programming cycles.
*18: PS with isolated analog option decreases efficiency by 0.5% and increases input current by 0.5%
*19: At rated output power.
*20: Max. ambient temperature for using IEEE is 45°C
*21: For Parallel operation more than 2 units 2% of toatal output current is requierd.

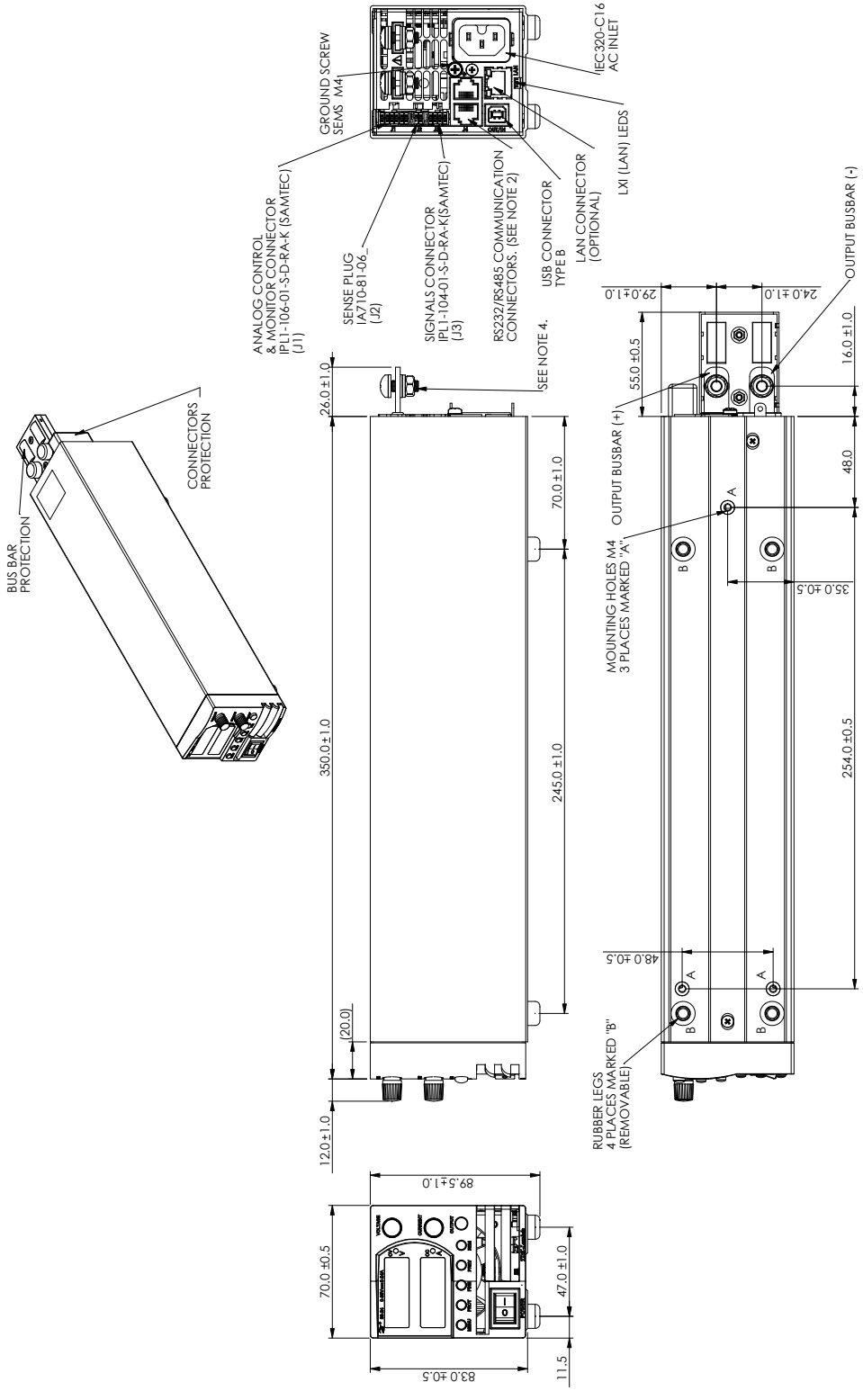
2.3 Supplemental Characteristics

The supplemental characteristics give typical but non-warranted performance characteristics. The supplemental characteristics are useful in assessing applications for the power supply. Several kinds of supplemental characteristics are listed below.

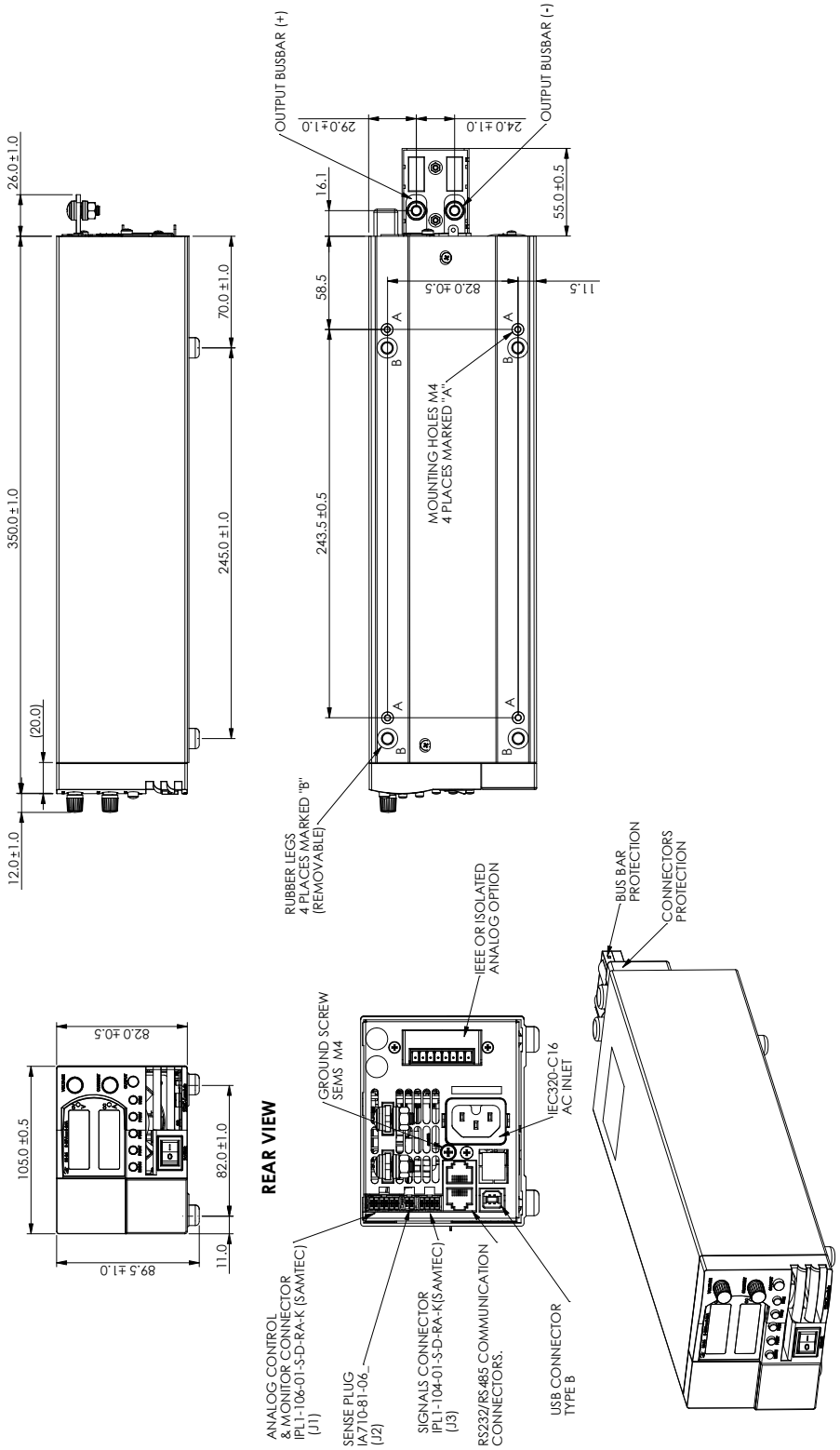
1. Evaluation Data: Typical performance of the power supply.
2. Reliability Data: Reliability performance of the power supply.
3. IEC61000 Data: Performance of the power supply under IEC61000 test conditions.
4. EMI Data: Typical EMI (conducted and radiated) performance of the power supply.

The supplemental characteristics data is held in each TDK-Lambda sales and service facility. For further details please contact the TDK-Lambda office near you.

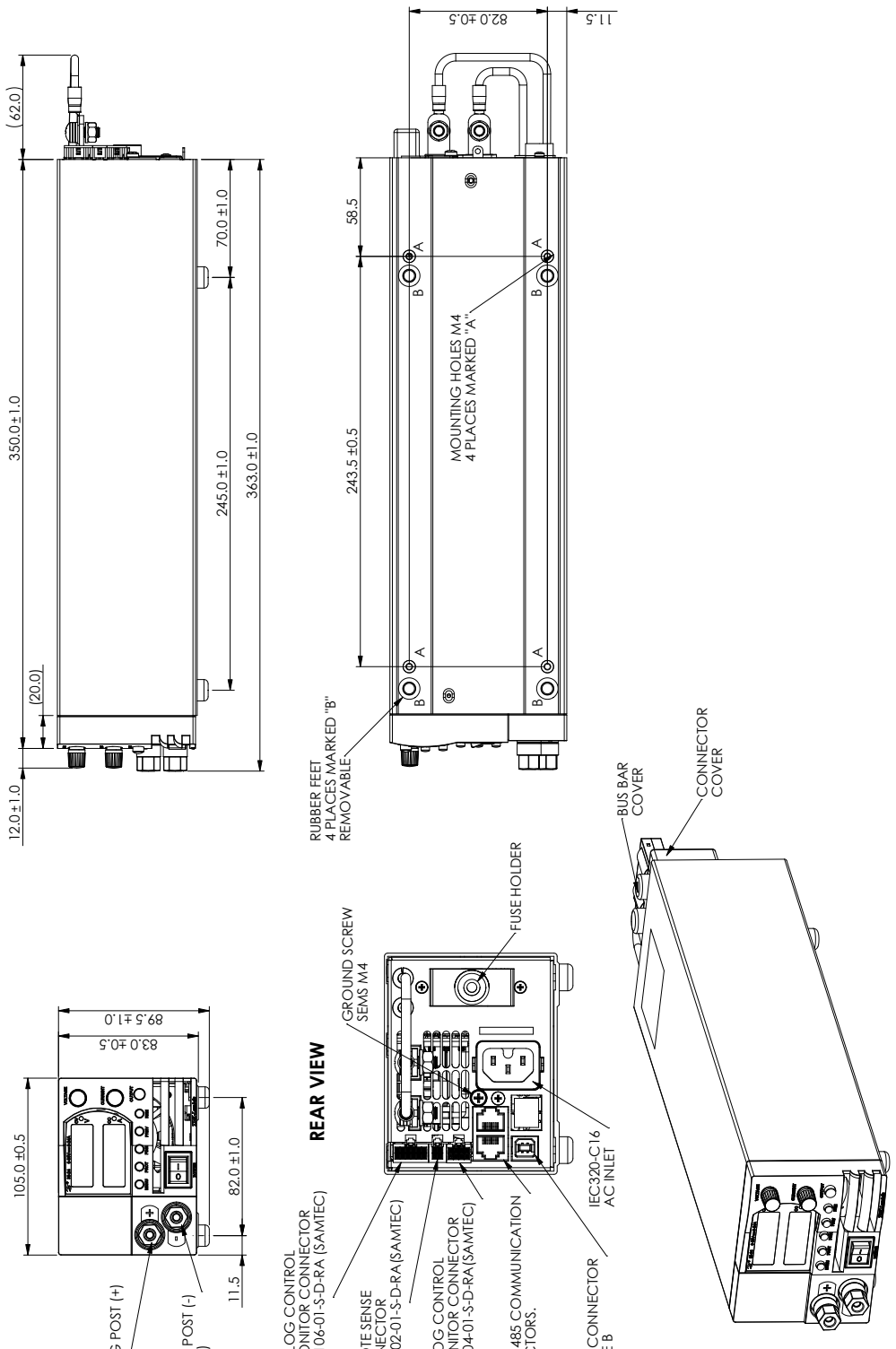
2.4 Z200W/400W Outline Drawing



2.5 Z200W/400W Optional IEEE, Isolated Analog Interface Outline Drawing



2.6 Z200W/400W Front Panel Output Binding Post Outline Drawing



CHAPTER 3: INSTALLATION

3.1 General

This chapter contains instructions for initial inspection, preparation for use and repackaging for shipment. Connection to PC, setting the communication port and linking Z^+ power supplies are described in Chapter 7.

NOTE:

Z^+ power supplies generate magnetic fields which might affect the operation of other instruments. If your equipment is susceptible to magnetic fields, do not position it adjacent to the power supply.

3.2 Preparation for Use

In order to be operational the power supply must be connected to an appropriate AC source. The AC source voltage should be within the power supply specification. Do not apply power before reading, Section 3.6 and 3.7.
Table 3-1 below, describes the basic setup procedure. Follow the instructions in Table 3-1 in the sequence given to prepare the power supply for use.

Step no.	Item	Description	Reference
1	Inspection	Initial physical inspection of the power supply	Section 3.3
2	Installation	Installing the power supply, Ensuring adequate ventilation.	Section 3.4 Section 3.5
3	AC source	AC source requirements Connecting the power supply to the AC source.	Section 3.6 Section 3.7
4	Test	Turn-on checkout procedure.	Section 3.8
5	Load connection	Wire size selection. Local /Remote sensing.	Section 3.9
6	Default setting	Single or multiple loads.	Section 7.2.1

Table 3-1: Basic setup procedure

3.3 Initial Inspection

Prior to shipment this power supply was inspected and found free of mechanical or electrical defects. Upon unpacking of the power supply, inspect for any damage which may have occurred in transit. The inspection should confirm that there is no exterior damage to the power supply such as broken knobs or connectors and that the front panel and meter faces are not scratched or cracked. Keep all packing material until the inspection has been completed. If damage is detected, file a claim with carrier immediately and notify the TDK-Lambda sales or service facility nearest you.

3.4 Rack Mounting

The Z^+ power supply series is designed to fit in a standard 19" 2U height rack.
Six units (70mm width) can be assembled into 19" 2U-rack. Refer to Fig.3-1.
Four units (105mm width) can be assembled into 19" 2U-rack. Refer to Fig.3-2

Fig.3-1

Fig.3-2

3.5 Location, Mounting and Cooling

This power supply is fan cooled. The air intake is at the front panel and the exhaust is at the rear panel. Upon installation allow cooling air to reach the front panel ventilation inlets. Allow minimum 10cm (4") of unrestricted air space at the front and the rear of the unit.
The power supply should be used in an area that the ambient temperature does not exceed +50°C.

Standort, Montage und Kühlung

Dieses Netzgerät ist gebläsegekühlt, mit vorderseitiger Luftaufnahme und rückseitigem Luftausstoß. Bei Installation ist darauf zu achten, dass die vorderseitigen Gebläseöffnungen ungehindert Luft aufnehmen können. Dazu muss vor und hinter dem Gerät ein Abstand von mindestens 10 cm zum nächsten Hindernis eingehalten werden. Das Netzgerät darf nur in einem Bereich benutzt werden, in dem die Umgebungstemperatur +50 °C nicht übersteigt.

3.6 AC Source Requirements

The Z^+ series can be operated from a nominal 100V to 240V, single phase, 47~63Hz. The input voltage range and current required for each model is specified in Chapter 2. Ensure that under heavy load, the AC voltage supplied to the power supply does not fall below the specifications described in Chapter 2.

Netzstromanforderungen

Die Geräte der Z^+ Serie können aus einem einphasigen Netzstromanschluss mit nominell 100-240 V und 47-63 Hz versorgt werden. Der für jedes Modell erforderliche Bereich von Eingangsspannung und Stromstärke ist in Kapitel 2 angeführt. Es ist sicherzustellen, dass der dem Netzgerät zugeführte Netzstrom bei hoher Belastung nicht unter die in Kapitel 2 angeführten Werte fällt.

3.7 AC Input Power Connection

WARNING:

Some components inside the power supply are at AC voltage even when the On/Off switch is in the "Off" position. To avoid electric shock hazard, disconnect the line cord and load and wait two minutes before removing cover.

WARNUNG:

Manche Komponenten im Netzteil stehen auch dann unter Wechselspannung, wenn sich der Ein-/Aus-Schalter in der „Aus"-Position befindet. Zur Vermeidung von Stromschlag müssen Netzkabel und Last getrennt werden. Warten Sie dann zwei Minuten, bevor Sie die Abdeckung entfernen.

3.7.1 AC Input Connector

An IEC connector is provided on the rear panel for connecting the unit to the AC power source with an AC cord. The IEC connector also provides the safety ground connection while the AC cord is plugged into an appropriate AC.

3.7.2 AC Input Cord

Refer to section 1.3.4 for details of the AC input cords recommended.

WARNING:

The AC input cord plug is the disconnect device of the power supply. The plug must be readily identifiable and accessible to the user. The AC input cord must be no longer than 3m.

WARNUNG:

Das Netzstromkabel dient zur Trennung des Netzgerätes vom Netzstrom. Der Stecker muss für den Benutzer leicht erkennbar und jederzeit zugänglich sein. Das Netzstromkabel darf nicht länger sein als drei Meter.

3.8 Turn-On Checkout Procedure

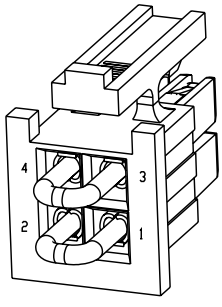
3.8.1 General

The following procedure ensures that the power supply is operational and may be used as a basic incoming inspection check.

3.8.2 Prior to Operation

1. Ensure that the power supply is configured to the default setting:
   AC On/Off switch at Off position.
   Sense connector : Configured to Local Sense as shown in Fig.3-3:

1 Local (-) sense
2 (-) Sense
3 (+) Sense
4 Local (+) sense



Plug P/N: IPD1-02-D-K
(SAMTEC)

Fig.3-3: Sense connector default connection

2. Ensure that the protection of output bus-bars or of output connector is mounted and properly assembled for power supplies with rated voltage exceed 70VDC.
3. Connect the unit to an AC source as described in section 3.7.
4. Connect a DVM with appropriate cables for the rated voltage to the output terminals.
5. Turn the front panel AC power switch to On.
6. When power supply is turned ON the display shows "8888" and all LEDs illuminate momentarily. The power supply operating status is then displayed.

3.8.3 Constant Voltage Check

1. Turn on the output by pressing OUT push-button so the OUT LED illuminates.
2. Observe the power supply VOLT display and rotate the Voltage Encoder.
   Ensure that the output voltage varies while the VOLT Encoder is rotated.
   The minimum control range is from zero to the maximum rated output for the power supply model. Compare the DVM reading with the front panel VOLT display to verify the accuracy of the VOLT display. Ensure that the front panel VOLT LED illuminates.
3. Turn off the front panel AC power switch.

3.8.4 Constant Current Check

Ensure that the front panel AC power switch is at Off position and the DVM connected to the output terminals shows zero voltage.

1. Connect DC shunt across the output terminals. Ensure that the shunt and the wires current ratings are higher than the power supply rating. Connect a DVM to the shunt.
2. Turn the front panel AC power switch to On position.
3. Turn on the output by pressing OUT push-button so the OUT LED illuminates.
4. Observe the power supply CURRENT display and rotate the CURRENT Encoder. Ensure that the output current varies while the CURRENT Encoder is rotate. The minimum control range is from zero to the maximum rated output for the power supply model. Compare the DVM reading with the front panel CURRENT display to verify the accuracy of the CURRENT display. Ensure that the front panel CURRENT LED is on.
5. Turn off the front panel AC power switch.
6. Remove the shunt from the power supply output terminals.

3.8.5 OVP Check

Refer to Section 5.3.2 for explanation of the OVP function prior to performing the procedure below.

1. Turn the front panel AC power switch to On position and turn on the output by pressing OUT push-button.
2. Using the VOLT Encoder, adjust the output voltage to approx. 10% of the unit voltage rating.
3. Set OVP to 50% of of the unit voltage rating.
4. Adjust the output voltage toward it's maximum and check that the output voltage cannot be increased more than the OVP setting.
5. Adjust OVP limit to the maximum.

3.8.6 UVL Check

The UVL can be set when the power supply output is Enabled (On) or Disabled (Off). UVL setting values are limited at the maximum level to approximately 5% below the Output Voltage setting. Attempting to adjust the value above this limit will result in no response to the adjustment attempt. The minimum value setting is zero.

1. Press PROT button. PROT (GREEN) LED illuminates. Current display shows "UUP" message.
2. Press Current Encoder. Voltage Display shows "UUL" message, Current display shows setting level.
3. Rotate the Voltage Encoder to set "UUL".
4. Rotate the Current Encoder to adjust the level.
5. Press PROT button twice or wait 15 sec. to return display to its previous state and then PREV LED turns OFF.
6. Adjust the output voltage toward it's minimum and check that the output voltage cannot be decreased below the UVL setting.
7. Adjust the UVL limit to the minimum.

3.8.7 Foldback Check

WARNING:

There is a potential shock hazard when checking a power supply with a rated output voltage greater than 70V. Observe proper safety procedures during the checking.

WARNUNG:

Beim Einsatz eines Netzteils mit einer Nenn-Ausgangsspannung von mehr als 70V besteht Stromschlaggefahr. Beachten Sie bei der Überprügung die entsprechenden Sicherheitsvorkehrungen.

Refer to Section 5.3.4 for explanation of the FOLD function prior to performing the procedure below.

1. Ensure that the output voltage is set to approx. 10% of the unit rating.
2. Adjust the CURRENT Encoder to set the current limit to approx. 10% of the unit rating.
3. Set Foldback to CC MODE.
4. Short the output terminals momentarily (approx. 0.5 sec.). Ensure that the output voltage falls to zero, the VOLT display shows "FOLd", CURRENT display shows "FAIL" and the ALARM LED blinks.
5. Set Foldback to OFF. The output voltage remains zero.
6. Press OUT button. Ensure that the output voltage returns to it's last setting.
7. Turn the output off by pressing OUT button. Ensure that the VOLT display shows "OFF".

3.9 Connecting the Load

Turn off the AC input power before making or changing any rear panel connection. Ensure that all connections are securely tightened before applying power. There is a potential shock hazard when using a power supply with a rated output greater than 70V.

WARNING:

There is a potential shock hazard when using a power supply with a rated output voltage greater than 70V. Turn off the AC input power before making or changing any rear panel connection. Ensure that the protection of output bus-bars or of output connector is mounted and properly assembled for power supplies with rated voltage exceed 70VDC. Ensure that all connections are securely tightened before applying power.

WARNUNG:

Beim Einsatz eines Netzteils mit einer Nenn-Ausgangsspannung von mehr als 70V besteht Stromschlaggefahr. Bevor ein Anschluss an der Geräterückseite erstellt oder verändert wird, schalten Sie die Stromversorgung AUS oder trennen Sie das Netzteil vom Netzstrom. Stellen Sie sicher, dass der Schutz der Ausgangssammelschiene oder des Ausgangs aufgesetzt und für Netzgeräte mit einer Nennspannung von über 70VDC angemessen montiert ist. Stellen Sie sicher, dass alle Anschlüsse fest sind, bevor Sie das Gerät an die Stromversorgung anschließen.

3.9.1 Load Wiring

The following considerations should be made to select wiring for connecting the load to the power supply:

- Current carrying capacity of the wire (refer to 3.9.2)
- Insulation rating of the wire should be at least equivalent to the maximum output voltage of the power supply.
- Maximum wire length and voltage drop (refer to 3.9.2)
- Noise and impedance effects of the load wiring (refer to 3.9.4).

3.9.2 Current Carrying Capacity

Two factors must be considered when selecting the wire size:

1. Wires should be at least heavy enough not to overheat while carrying the power supply load current at the rated load, or the current that would flow in the event the load wires were shorted, whichever is greater.
2. Wire size should be selected to enable voltage drop per lead to be less than 1.0V at the rated current. Although units will compensate higher voltage drop in each load wire (refer to the specifications). It is recommended to minimize the voltage drop (1V maximum) to prevent excessive output power consumption from the power supply and poor dynamic response to load changes. Please refer to Tables 3-2 and 3-3 for maximum wire length to limit voltage drop in American and European dimensions respectively.

Wire size AWG	Resistivity Ohm/1000ft	Maximum length in feet to limit voltage drop to 1V or less			
		5A	10A	20A	50A
14	2.526	80	40	20	8
12	1.589	120	60	30	12
10	0.9994	200	100	50	20
8	0.6285	320	160	80	32
6	0.3953	500	250	125	50
4	0.2486	800	400	200	80
2	0.1564	1200	600	300	125
0	0.0983	2000	1000	500	200

Table 3-2: Maximum wire length for 1V drop on lead (in feet)

Cross sect. area (mm^2)	Resistivity Ohm/Km	Maximum length in meters to limit voltage drop to 1V or less			
		5A	10A	20A	50A
2.5	8.21	24.0	12	6	2.4
4	5.09	39.2	18.6	9.8	4
6	3.39	59.0	29.4	14.8	5.8
10	1.95	102.6	51.2	25.6	10.2
16	1.24	160.0	80	40	16
25	0.795	250.0	125	62	25.2
35	0.565	354.0	177	88	35.4

Table 3-3: Maximum wire length for 1V drop on lead (in meters)

For currents not shown in Table 3-2 and 3-3, use the formula:

Maximum length=1000/(current x resistivity)

Where current is expressed in amperes and resistivity in ohms/km or ohms/1000ft.

3.9.3 Wire Termination

The wires should be properly terminated with terminals securely attached. DO NOT use non terminated wires for load connection at the power supply.

CAUTION:

When local sensing, a short from +LS or +S to -V or -S or -LS, will cause damage to the power supply. Reversing the sense wires might cause damage to the power supply in local and remote sensing. (Do not connect -S to +V or +S to -V.)

3.9.4 Noise and Impedance Effects

To minimize the noise pickup or radiation, the load wires and remote sense wires should be twisted pairs to the shortest possible length. Shielding of sense leads may be necessary in high noise environments. Where shielding is used, connect the shield to the chassis via a rear panel Ground screw. Even if noise is not a concern, the load and remote sense wires should be twisted-pairs to reduce coupling, which might impact the stability of power supply. The sense leads should be separated from the power leads.

Twisting the load wires reduces the parasitic inductance of the cable which could produce high frequency voltage spikes at the load and the output of power supply, because of current variation in the load itself.
The impedance introduced between the power supply output and the load could make the ripple and noise at the load worse than the noise at the power supply rear panel output. Additional filtering with bypass capacitors at the load terminals may be required to bypass the high frequency load current.

3.9.5 Inductive Loads

Inductive loads can produce voltage spikes that may be harmful to the power supply. A diode should be connected across the output. The diode voltage and current rating should be greater than the power supply maximum output voltage and current rating. Connect the cathode to the positive output and the anode to the negative output of the power supply.
Where positive load transients such as back EMF from a motor may occur, connect a surge suppressor across the output to protect the power supply. The breakdown voltage rating of the suppressor must be approximately 10% higher than the maximum output voltage of the power supply.

3.9.6 Making the Load Connections

WARNING:

There is a potential shock hazard when using a power supply with a rated output voltage greater than 70V. To protect personnel against accidental contact with hazardous voltages, ensure that the protection of output bus-bars or of output connector is mounted and properly assembled. Ensure that the load and its connections have no accessible live parts. Ensure that the load wiring insulation rating is greater than or equal to the maximum output voltage of the power supply.

WARNUNG:

Beim Einsatz eines Netzteils mit einer Nenn-Ausgangsspannung von mehr als 70V besteht Stromschlaggefahr. Zum Schutz des Personals vor versehentlichem Kontakt mit gefährlichen Spannungen ist sicherzustellen, dass der Schutz der Ausgangssammelschiene oder des Ausgangs aufgesetzt und angemessen montiert ist. Stellen Sie sicher, dass an der Last und deren Verbindungen keine zugänglichen spannungsführenden Teile vorhanden sind. Stellen Sie sicher, dass der Isolationswert der Last höher als oder gleich der maximalen Ausgangsspannung des Netzgerätes ist.

CAUTION:

Ensure that the load wiring mounting hardware does not short the output terminals. Heavy connecting cables must have some form of strain relief to prevent loosening the connections or bending the bus-bars.

10V to 100V Models

Refer to Fig.3-4 for connection of the load wires to the power supply bus-bars and to Fig.3-5 for mounting the bus-bars shield to the chassis.

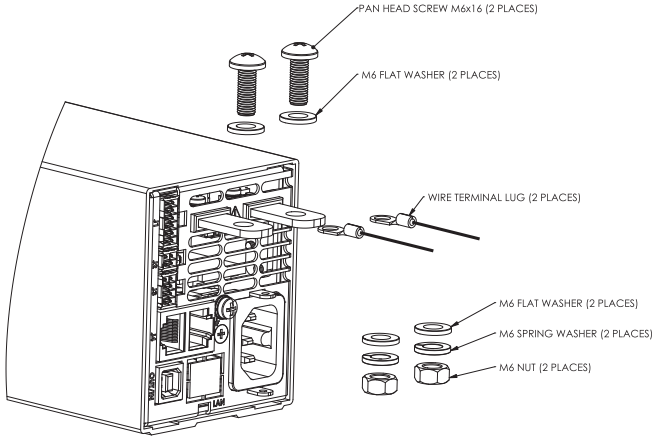

PAN HEAD SCREW M6x16 (2 PLACES)
M6 FLAT WASHER (2 PLACES)
WIRE TERMINAL LUG (2 PLACES)
M6 FLAT WASHER (2 PLACES)
M6 SPRING WASHER (2 PLACES)
M6 NUT (2 PLACES)

Fig. 3-4: Load wires connection, 10V to 100V models.

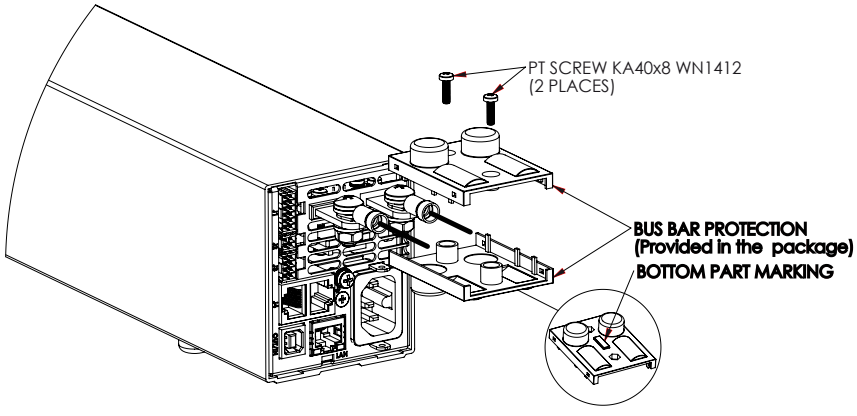


Fig. 3-5: Bus-bars shield mounting

100V Models

WARNING:

There is a potential shock hazard when using a power supply with a rated output voltage greater than 70V. Do not turn ON power supply with rated output voltage above 70VDC without output bus-bars or output connector protection assembled.

Ensure that the protection of output bus-bars or of output connector is mounted and properly assembled, and that the bus bar protection is locked by a two SEMS type screws as described in Fig. 3.5

WARNUNG:

Beim Einsatz eines Netzteils mit einer Nenn-Ausgangsspannung von mehr als 70V besteht Stromschlaggefahr. Bevor ein Anschluss an der Geräterückseite erstellt oder verändert wird, schalten Sie die Stromversorgung AUS oder trennen Sie das Netzteil vom Netzstrom. . Stellen Sie sicher, dass der Schutz der Ausgangssammelschiene oder des Ausgangs aufgesetzt und angemessen montiert ist, sowie dass der Schutz der Sammelschiene mittels zweier SEMS-Schrauben verriegelt wurde, wie in Abb. 3.5 beschrieben.

3.9.7 Connecting Single Loads, Local Sensing (default)

Fig.3-6 shows recommended load and sensing connections for a single load. The local sense lines shown are default connections at the rear panel J2 sense connector. Local sensing is suitable for applications where load regulation is less critical.

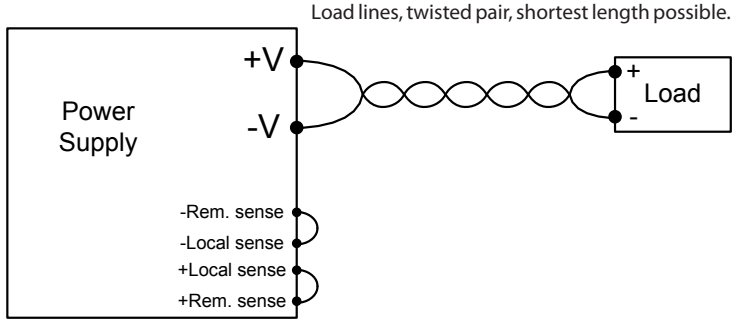


Fig.3-6: Single load connection, local sensing

3.9.8 Connecting Single Loads, Remote Sensing

Fig.3-7 shows recommended remote sensing connection for single loads. Remote sensing is used when, in Constant Voltage mode, the load regulation is important at the load terminals. Use twisted or shielded wires to minimize noise pick-up. If shielded wires are used, the shield should be connected to the ground at one point, either at the power supply chassis or the load ground. The optimal point for the shield ground should be determined by experimentation.

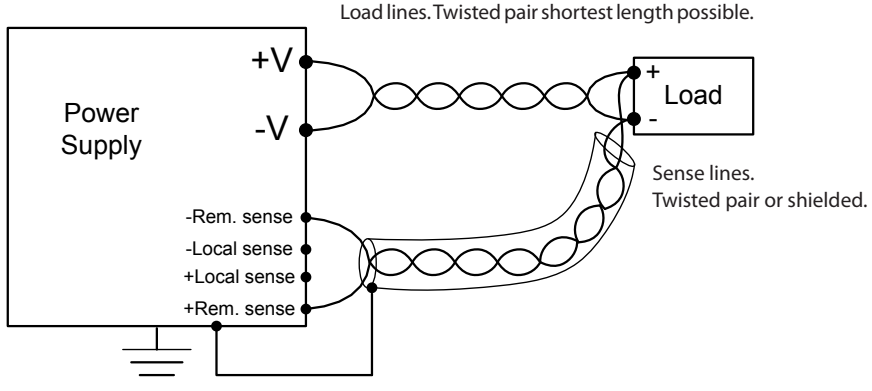


Fig.3-7: Remote sensing, single load

3.9.9 Connecting Multiple Loads, Radial Distribution Method

Fig.3-8 shows multiple loads connected to one supply. Each load should be connected to the power supply's output terminals using separate pairs of wires. It is recommended that each pair of wires will be as short as possible and twisted or shielded to minimize noise pick-up and radiation. The sense wires should be connected to the power supply output terminals or to the load with the most critical load regulation requirement.

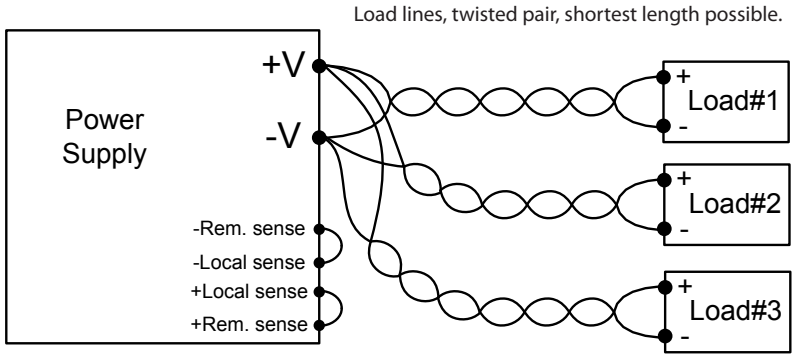


Fig.3-8: Multiple loads connection, radial distribution, local sense

3.9.10 Multiple Load Connection with Distribution Terminals

If remotely located output distribution terminals are used, the power supply output terminals should be connected to the distribution terminals by a pair of twisted and/or shielded wires. Each load should be separately connected to the remote distribution terminals (see Fig.3-9).
If remote sensing is required, the sensing wires should be connected to the distribution terminals or at the most critical load.

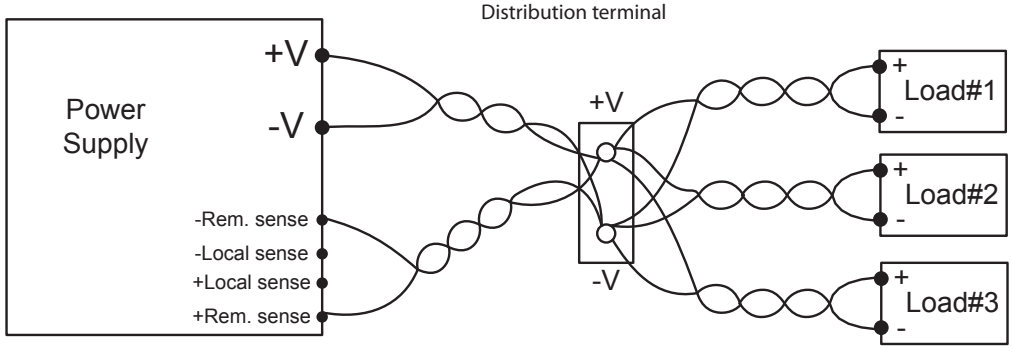


Fig.3-9: Multiple loads connection with distribution terminal

3.9.11 Grounding Outputs

Either the positive or negative output terminals can be grounded. To avoid noise problems caused by common-mode current flowing from the load to ground, it is recommended to ground the output terminal as close as possible to the power supply chassis ground.

Always use two wires to connect the load to the power supply regardless of how the system is grounded.

WARNING:

Models up to 100VDC Rated Output shall not float outputs more than +/-100VDC above/below chassis ground.

WARNUNG:

Bei Modellen bis 100VDC Nennausgangsspannung darf der Potentialunterschied zwischen Ausgang und Gehäuse-Erdung nicht mehr als +/-100VDC betragen.

3.10 Local and Remote Sensing

The rear panel J2 sense connector is used to configure the power supply for local or remote sensing of the output voltage. Refer to Fig.3-10 for sense connector location.

3.10.1 Sense Wiring

WARNING:

There is a potential shock hazard at the sense connector when using a power supply with a rated output voltage greater than 70V. Local sense and remote sense wires should have a minimum insulation rating equivalent or greater than the maximum output voltage of the power supply. Ensure that the connections at the load end are shielded to prevent accidental contact with hazardous voltages.

3.10.2 Local Sensing

The power supply is shipped with the rear panel J2 sense connector wired for local sensing of the output voltage. Refer to Table 3-4 for J2 terminals assignment. With local sensing, the output voltage regulation is made at the output terminals. This method does not compensate for voltage drop on the load wires, therefore it is recommended only for low load current applications or where the load regulation is less critical.

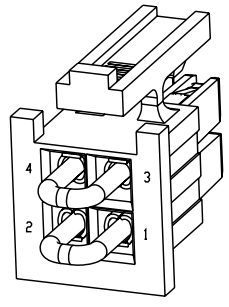


Fig.3-10: Sense connector location

Terminal	Function
J2-1	Local negative sense. Connected internally to the negative output terminal (-LS).
J2-2	Remote negative sense (-S).
J2-3	Remote positive sense (+S).
J2-4	Local positive sense. Connected internally to the positive output terminal (+LS).

Table 3-4: J2 terminals

3.10.3 Remote Sensing

WARNING:

There is a potential shock hazard at the sense point when using power supply with a rated output voltage greater than 70V. Ensure that the connections at the load end are shielded to prevent accidental contact with hazardous voltages.

WARNUNG:

Wird ein Netzgerät mit einer Nennausgangsspannung von über 70V verwendet, besteht potentielle Stromschlaggefahr am Fühlpunkt. Es ist sicherzustellen, dass die Anschlüsse an den Last-Terminals geschützt sind, um versehentliche Berührung mit gefährlichen Spannungswerten zu verhindern.

WARNING:

Do not operate the Power Supply with remote sense wire connected to the load without connecting load wire to the output terminal. Make sure that the connection is reliable to avoid disconnection during operation. Disconection may cause damage to the power supply.

CAUTION:

When using shielded sense wires, ground the shield in one place only. The location can be the power supply chassis or one of the output terminals.

Use remote sense where the load regulation at the load end is critical. In remote sense, the power supply will compensate for voltage drop on the load wires. Refer to the specifications for the maximum voltage drop on load wires. The voltage drop is subtracted from the total voltage available at the output. Follow the instructions below to configure the power supply for remote sensing:

1. Ensure that the AC On/Off is in the Off position.
2. Remove the local sense jumpers from J2.
3. Connect the negative sense lead to terminal J2-2 (-S) and the positive sense lead to terminal J2-3(+S) of the J2 mating connector. Ensure that the J2 mating connector is plugged securely into the rear panel sense connector, J2.
4. Turn On the power supply.

NOTES:

1. If the power supply is operating in remote sense and either the positive or negative load wire is not connected, an internal protection circuit will activate and shut down the power supply. To resume operation, turn the AC On/Off to the Off position, connect the open load wire, and turn On the power supply.
2. If the power supply is operated without the remote sense lines or local sense jumpers, it will continue to work, but the output voltage regulation will be degraded. Also, the OVP circuit may activate and shut down the power supply.

3.10.4 J2 Sense Connector Technical Information

- J2 connector type: IPL1-102-01-S-D-RA-K, SAMTEC.
- Plug type: IPD1-02-D-K, SAMTEC.
- Contact pins: CC79R-2024-01-L, SAMTEC.
- Wire AWG: 24 up to 20

3.11 Repackaging for Shipment

To ensure safe transportation of the instrument, contact the TDK-Lambda sales or service facility near you for Return Authorization and shipping information. Please attach a tag to the power supply describing the problem and specifying the owner, model number and serial number of the power supply. Refer to Warranty Information for further instructions.

CHAPTER 4: FRONT/REAR PANEL CONTROLS AND CONNECTORS

4.1 Introduction

The Z+ Power Supply series has a full set of controls, indicators and connectors that allow the user to set up and operate the unit. Before starting to operate the unit, please read the following sections for an explanation of the functions, controls and connector terminals.
- Section 4.2: Front Panel Display and Controls.
- Section 4.3: Rear Panel Controls and Connectors.

4.2 Front Panel Display and Controls

Refer to Fig4-1 and Table 4-1 for description of the Front Panel controls and indicators.

Fig. 4-1: Front panel controls and indicators

No.	Control/Indicator	Description	Section
1	AC Power Switch	AC ON/OFF control	
2	Current Display	4 digit 7-segment LED display. Normally displays the output current. In preview mode, the display indicates the program setting of output current.	
3	Voltage Display	4 digit 7-segment LED display. Normally displays the output voltage. In preview mode, the display indicates the program setting of output voltage.	
4	Voltage Encoder and button	Encoder : high resolution rotary Encoder for adjusting the output voltage. Button: Auxiliary function to select between menu levels.	5.2.1
5	Constant Voltage mode indicator	Green LED, light for Constant-Voltage mode operation.	
6	Current Encoder and button	Encoder: High resolution rotary Encoder for adjusting the output current. Button: Auxiliary function to select between menu levels.	5.2.2
7	Constant Current mode indicator	Green LED, light for Constant-Current mode operation.	
8	OUT button/indicator	Main function: output ON/OFF control. Press OUT to set the output ON or OFF. Press to recovery after OVP, UVP or FOLD fails. Green LED, lights when the DC Output is enabled. Auxiliary function: Select between Safe Start and Auto Start modes.	5.2.4 5.2.5
9	REM button/indicator	Main function: Go to local. Press REM to put the unit into local (REM button is disabled at Local Lockout mode. Green LED, lights when the unit is in communication Remote mode. Auxiliary function: Communication menu.	
10	PREV button/indicator	Main function: Press PREV to display the output voltage and current limit setting. For 5 sec. the display will show the setting and then it will return to show the actual output voltage and current. Green LED, lights when PREV button is pressed. Auxiliary function: Front Panel Lock. Press and hold PREV button to toggle between "Locked front panel" and "Unlocked front panel". The display will cycle between LFP and UFP. Releasing the PREV button while one of the modes is displayed, selects that mode.	
11	FINE button/indicator	Voltage, Current, Delay and Counter Fine/Coarse adjustment control. Operates as a toggle switch. In Fine mode, the VOLTAGE and CURRENT Encoders operate with high resolution and in Coarse mode with lower resolution (approx. 6 turns). Green LED, lights when the unit is in Fine mode.	
12	PROT button/ Alarm indicator	Main function: Red LED blinks in cases of fault detection: OVP, UVP, OTP, Foldback, Interlock and AC fail. Auxiliary function: Protection menu. Green LED illuminates when the unit is in protection menu mode.	5.3
13	Main Menu button/ indicator	Used for selection between analog or digital mode control, rear panel control parameters, memory management, trigger and program setting, parallel mode settings and software version.	
14	Optional Output Jack	Output Jacks for modules up to 60V: 25A Max	

Table 4-1: Front panel controls and indicators

4.3 Rear Panel Connectors

Refer to Fig.4-2 and Table 4-2 for description of the Rear Panel connectors.

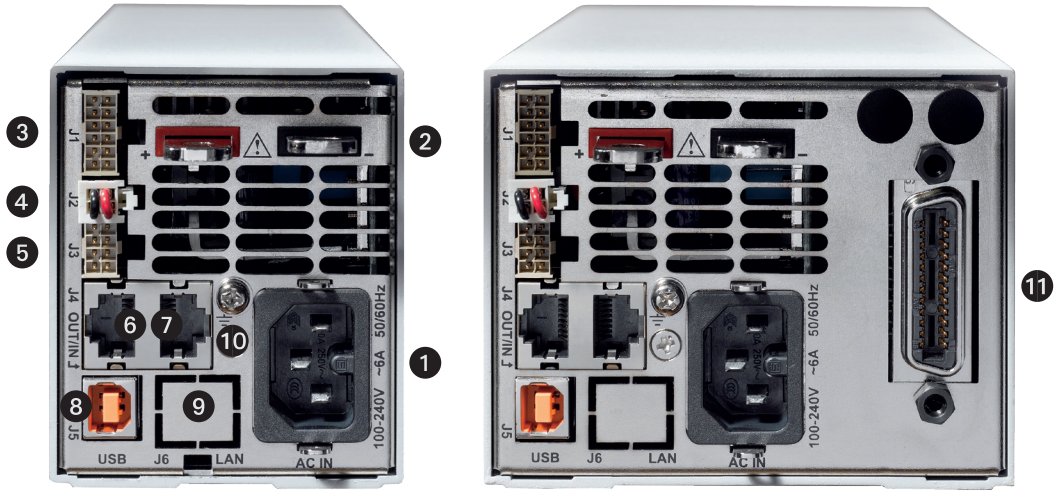


Fig. 4-2: Rear panel connections

No.	Connection	Description	Section
1	AC Input Connector	IEC320-16 TYPE CONNECTOR	
2	DC output bus-bar	Bus-bars for 10V to 100V models. Use M6 or 1/4" screws.	3.9.9
3	Analog Control and signals. J1	Connector for remote analog interface. Analog control and monitoring. Referenced internally to output potential -S.	4.3.1
4	Local/Remote sense connector J2	Connector for making remote sensing connections to the load for regulation of the load voltage and compensation of load wire drop.	3.8.1 3.10.2
5	Isolated control and signal. J3	Control and monitoring signal, isolated from the output potential.	4.3.2
6	Remote Serial Out connector	RJ-45 type connector, used for chaining power supplies to/from a serial communication bus.	7.3
7	Remote Serial In connector	RJ-45 type connector, use for connecting power supplies to RS232 or RS485 port of computer for remote control purposes. When using several power supplies in a power system, the first unit Remote-In is connected to the computer and the remaining units are chained, Remote-In to Remote-Out.	7.3
8	USB Connector	USB interface connector, type B	
9	LAN Connector (optional)	LAN interface connector, type RJ-45	
10	Ground screw	M4x10 for chassis Ground connection	
11	Optional Interface	Position for GPIB Interface (shown) or Isolated Analog Interface.	

Table 4-2: Rear panels connecions

WARNING:

Terminals 7, 9 and 12 of J1 are connected internally to the negative sense(-S) potential of the power supply. Do not attempt to bias any of these terminals relative to the negative sense. Use the Isolated Programming interface option to allow control from a programming source at a different potential relative to the power supply negative.

CAUTION:

To prevent ground loops and to maintain the isolation of the power supply when programming from J1, use an ungrounded programming source.

WARNING:

There is a potential shock hazard at the output when using a power supply with rated output greater than 70V. Use wires with minimum insulation rating equivalent to the maximum output voltage of the power supply.

WARNUNG:

Beim Einsatz eines Netzteils mit einer Nenn-Ausgangsspannung von mehr als 70V besteht Stromschlaggefahr am Ausgang. Es sind Drähte mit minimalem Isolierwert zu verwenden, welcher der maximalen Ausgangsspannung des Netzgerätes entspricht.

4.3.1 J1 Connector Terminal and Function

Control and monitoring signals are referenced to the negative sense potential (-S).

Connector Technical Information:

- Connector type: IPL1-106-01-S-D-RA-K, SAMTEC
- Receptacle type: IPD1-06-D-K, SAMTEC
- Contact pins: CC79R-2024-01-L, SAMTEC
- Hand tool: CAT-HT-179-2024-11, SAMTEC
- Wire: AWG 20-24

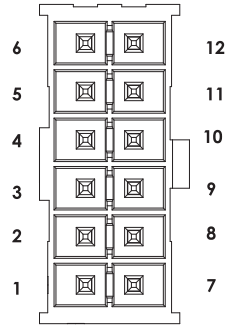


Fig.4-3: J1 connector terminals and functions

Pin	Parameter	Specification	Section
1	LOC/REM SELECT	Input for selecting between Local or Remote analog programming of output voltage and output current.	6.2
2	P	Output for current balance in parallel operation	5.5
3	I_MON	Monitoring power supply output current	6.6
4	LOC/REM MON	Output for indicating if the unit is in Local or Remote analog programming mode.	
5	IPGM	Input for remote analog voltage/resistance programming of the Output Current.	6.4, 6.5
6	VPGM	Input for remote analog voltage/resistance programming of the Output Voltage.	6.4, 6.5
7	COM	Control Common. Return for VMON, IMON, CV/CC, LOC/REM. Connected internally to the negative sense potential (-S).	
8	CV/CC	Output for Constant-Voltage / Constant-Current mode indication.	5.8.1
9	COM	Control Common. Return for VMON, IMON, CV/CC, LOC/REM. Connected internally to the negative sense potential (-S).	
10	V_MON	Output for monitoring the power supply Output Voltage.	6.6
11	IPGM_RTN	Return for IPGM input.	
12	VPGM_RTN	Return for VPGM input. Connected internally to the " -S".	

Table 4-3: J1 connector terminals and functions

4.3.2 J3 Connector Terminal and Function

Control and monitoring signals are isolated from the power supply output.

Connector Technical Information

- Connector type: IPL1-104-01-S-D-RA-K, SAMTEC
- Receptacle type: IPD1-04-D-K, SAMTEC
- Contact pins: CC79R-2024-01-L, SAMTEC
- Hand tool: CAT-HT-179-2024-11, SAMTEC
- Wire AWG 20-24

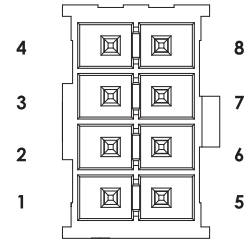


Fig.4-4: J3 connector terminals and functions

Pin	Signal name	Function	Section
1	Programmed Signal 1	General Purpose Open collector Port 1	5.7.3
2	PS_OK	Output for indication of the power supply status. High level is OK.	5.7.4
3	Trigger Out	Trigger output, positive true, pulse width: Min. 10usec	8.5.2
4	ILC	Enable /Disable the power supply output by dry-contact (short/open).	5.7.2
5	Shut Off (SO)	Input for shut off control of the power supply output.	5.7.1
6	Programmed Signal 2	General Purpose Open collector Port 2	5.7.3
7	IFC_COM	Isolated interface, common.	
8	Trigger In	CMOS level input for triggering power supply output. Positive edge, minimum pulse width: Min. 10usec.	8.5.1

Table 4-4: J3 connector terminals and functions

4.4 Front Panel Display Messages

Table 4-5 shows the various messages that will be shown on the display in different operating modes.

Display Text	Text Description
Abor	ABORT
AC	AC
Adr	ADDRESS
AUtO	AUTO[start]
bAUd	BAUD RATE
bUS	BUS
COUn	COUNTER
Curr	CURRENT
CC	CC
CU	CV
d iS	DISABLE
EnA	ENABLE
ErES	EXT.RESISTOR
Err	ERROR
EUOL	EXT.VOLTAGE
EHt	EXTERNAL
F.rSt	FACTORY RESET
FAI L	FAIL
FOLd	FOLDBACK
F.PAn	FRONT PANEL
F.Str	FUNCTION STROBE
GEn	GEN LANGUAGE
POS	POSITIVE
HOSt	HOST
inFo	INFORMATION
in it	INITIALIZE
I ntF	INTERFACE
I LC	INTERLOCK
I P	IP
LAn	LAN
LAnG	LANGUAGE
nEG	NEG

Display Text	Text Description
iAC	MAC
iEnO	MEMORY
OFF	OFF
On	ON
OnCE	ONCE
OtP	OTP
OUP	OVP
P in1	PIN 1
P in2	PIN 2
PrOG	PROGRAM
Pr.dL	PROTECT DELAY
rAnG	RANGE
r.PAn	REAL PANEL
rECL	RECALL
rSt	RESET
SAFE	SAFESTART
SAUE	SAVE
SCPI	SCPI
SO	SHUT OFF
SEt	SET
SLUE	SLAVE
SLAd	SLAVE (ADVANCED)
SL	SLAVE (BASIC)
StEP	STEP
tr iG	TRIGGER
tr.dL	TRIGGER DELAY
tr.I n	TRIGGER IN
tr.Ou	TRIGGER OUT
USb	USB
UUL	UVL
UUP	UVP
OFF	OFF

Table 4-5: Front Panel display messages

4.5 Navigating the Main Menu

4.5.1 Introduction

The Main Menu consists of three levels: Subsystem, Function and Parameter. To enter the Menu press the Menu button. The Menu LED illuminates and the display shows the Subsystem Menu. Navigate by rotating the Voltage Encoder to scroll through the Subsystem list (first level). Repeat these actions to navigate the Functions list (second level). In the third level, the Voltage display shows the function and the Current display shows the parameter. Scroll the parameter list by rotating the Current Encoder and press to select the desired parameter. When parameter is accepted, the display blinks once and exits to the previous level.

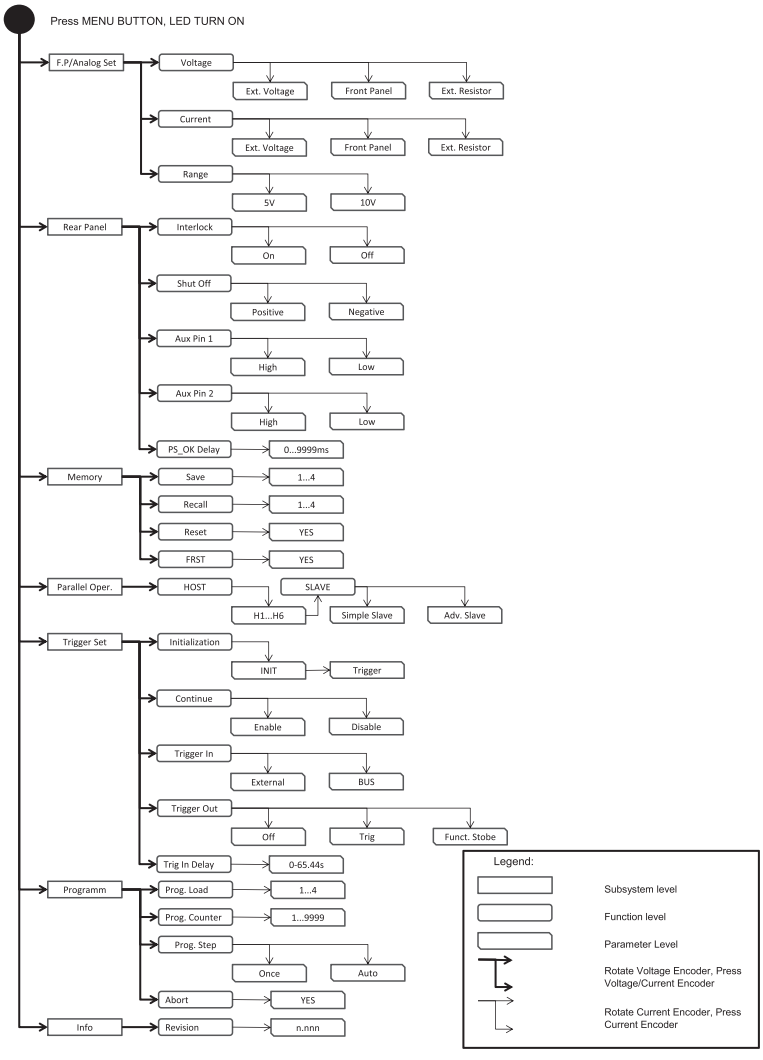


Fig.4-5: Main Menu diagram

4.5.2 Exiting the Main Menu

There are three ways to exit from Main Menu:

1. Press MENU button three times. MENU LED turns OFF. Display shows present status of power supply.
2. Press and hold MENU button 3sec. MENU LED turns OFF. Display shows present status of power supply.
3. No action for 15 sec. MENU LED turns OFF. Display shows present status of power supply.

4.6 Navigating Communication Menu

4.6.1 Introduction

The Communication Menu consists of two /three levels: Function level and Parameter level.

To navigate the Communication Menu press REM button. The REM LED illuminates. The function menu item appears on the display. Navigate by rotating the Voltage Encoder to scroll the function level. To select the desired function, press the Encoder button next to the display. In the Parameter level, the Voltage display shows the function and the Current display shows the parameter. Scroll the parameter list by rotating the Current Encoder and press to select the desired parameter. When parameter is accepted, the display blinks once and exits to the previous level.

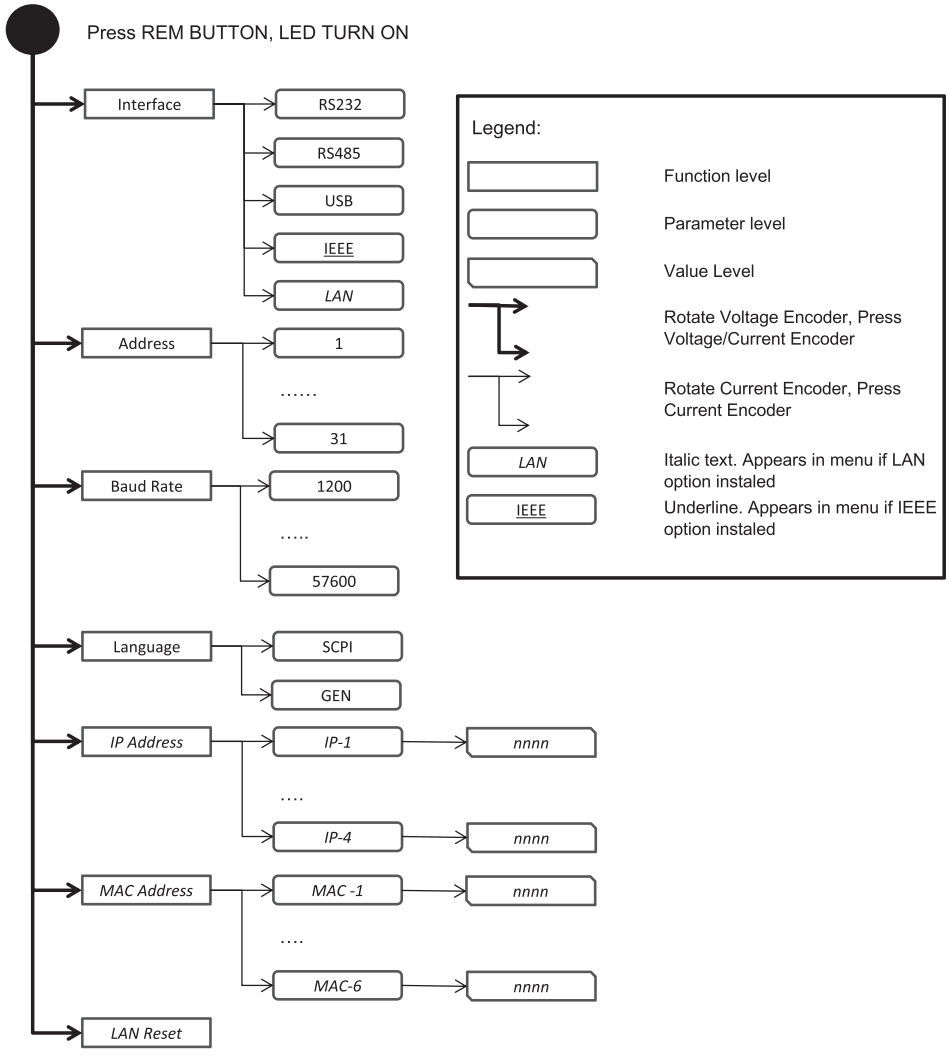


Fig.4-6: Communication Menu diagram

4.6.2 Exiting the Communication Menu

There are three ways to exit from REM menu:

1. Press twice on REM button. REM LED turns OFF. Display shows present status of power supply.
2. Press and hold REM button 3sec. REM LED turns OFF. Display shows present status of power supply.
3. No action for 15sec. REM LED turns OFF. Display shows present status of power supply.

4.7 Navigating the Protection Menu

4.7.1 Introduction

The Protection Menu consists of two levels: Function and Parameter.

To navigate the Protection Menu press PROT button. The PROT GREEN LED illuminates. The function menu item appears on the display. Navigate by rotating the Voltage Encoder to scroll the function level. To select the desired function, press the Encoder button next to the display. Toggle the Voltage Encoder to select either UVL or UVP functions.

In the Parameter level, the Voltage display shows the function and the Current display shows the parameter. Scroll the parameter list by rotating the Current Encoder. Selection of a numerical parameter is automatic and the Encoder cannot be pressed. Press only to select Foldback parameter. When parameter is accepted the display blinks once and exits to the previous level.

4.7.2 Exiting the Protection Menu

There are three ways exit the menu:

1. Press PROT button twice. PROT LED turns OFF. Display shows present status of power supply.
2. Press and hold Menu button 3sec. PROT LED turns OFF. Display shows present status of power supply.
3. No action for 15sec. PROT LED turns OFF. Display shows present status of power supply.

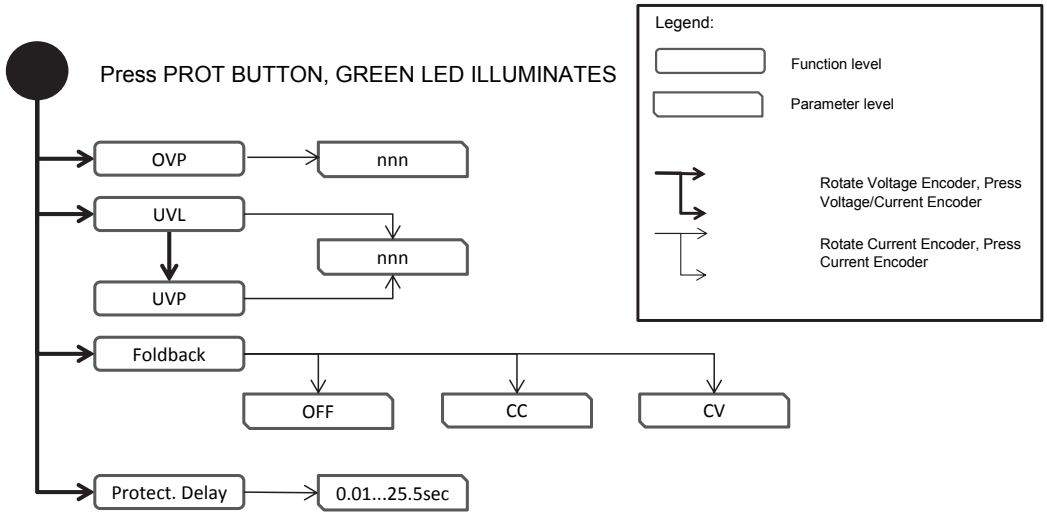


Fig.4-7: Protection Menu Navigation

CHAPTER 5: LOCAL OPERATION

5.1 Introduction

This Chapter describes the operating modes that do not require programming and monitoring the power supply via its serial communication ports. USB or RS232/RS485 or by remote analog signals. Ensure that the REM/LOC LED on the front panel is Off, (indicating Local mode). If the REM/LOC LED is On, press the front panel REM/LOC button to change the operating mode to local.
- For information regarding remote analog programming refer to Chapter 6.
- For information regarding usage of the serial communication port refer to Chapter 7.

5.2 Standard Operation

The power supply has two basic operating modes: Constant Voltage mode and Constant Current mode. The mode in which the power supply operates at any given time depends on the output voltage setting, output current limit setting and the load resistance.

5.2.1 Constant Voltage Mode and Voltage Setting

1. In constant voltage mode, the power supply regulates the output voltage at the selected value, while the load current varies as required by the load.
2. While the power supply operates in constant voltage mode, the VOLTAGE LED on the front panel illuminates.
3. Adjustment of the output voltage can be made when the power supply output is enabled (Output On) or disabled (Output Off). When the output is enabled, simply rotate the VOLTAGE Encoder knob to program the output voltage. When the output is disabled, press the PREV button and then rotate the VOLTAGE Encoder to required value. The Voltage display will show the programmed output voltage for 5 seconds. Then "OFF" will appear on the Voltage display.
4. Resolution can be set to Coarse or Fine adjustment. Press FINE button to select between the lower and higher resolution. The FINE LED illuminates when the resolution is set to Fine.

NOTE:

If after completing the adjustment, the display shows a different value than the setting, the power supply may be at current limit. Check the load condition and the power supply current limit setting.

NOTE:

The maximum and minimum setting values of the output voltage are limited by the Over Voltage protection and Under Voltage limit setting. Refer to sections 5.3.2 and 5.3.3 for more details.

5.2.2 Constant Current Mode and Current Setting

1. In constant current mode, the power supply regulates the output current at the selected value, while the voltage varies with the load requirement.
2. While the power supply is operating in Constant Current mode, the Current LED illuminates.
3. Adjustment of the output current can be made when the power supply output is enabled (Output On) or disabled (Output Off). When the output is enabled, simply rotate the Current Encoder knob to program the output current. When the output is disabled, press the PREV button and then rotate the Current Encoder to required value. The Current display will show the programmed output current for 5 seconds. Then "OFF" will appear on the Voltage display.
4. Resolution can be set to Coarse or Fine adjustment. Press the FINE button to select between the Coarse and Fine adjustment. The FINE LED illuminates when the resolution is set to Fine.

5.2.3 Automatic Crossover

When the power supply operates in Constant Voltage mode, while the load current is increased to greater than the current limit setting, the power supply will automatically switch to Constant Current mode. If the load is decreased to less than the current limit setting, the power supply will automatically switch back to Constant Voltage mode.

5.2.4 Output On/Off Control

The Output On/Off enables or disables the power supply output. The Output On/Off can be activated from the front panel using the OUT button or from the communication interface. The OUT button can be pressed at any time (except in Front Panel Lock mode or when a Fault condition exists). When the output is disabled, the output voltage and current fall to zero and the Voltage display shows "OFF". Press the OUT button to recover from Faults such as: OVP, UVP and FOLD faults, after the Fault conditions have been removed.

5.2.5 Safe Start and Auto-Restart Modes

At turn on, the power supply AC On/Off can start at last setting of Output Voltage and Current limit with the output enabled (Auto-restart), or it can start with the output disabled (Safe mode). Press and hold the OUT button to toggle between Safe start and Auto-restart modes. The VOLTAGE display will continuously cycle between "SAFE" and "AUTO" every 3 seconds. Releasing OUT push button while one of the modes is displayed, selects that mode. The default setting at shipment is in Safe mode.

- Automatic Start Mode (AUTO)
  The power supply is restored to last operation setting. Upon start-up, the output is enabled or disabled according to the last setting.
- Safe Start Mode (SAFE)
  The power supply is restored to last operation setting and sets the Output to Off state. At start-up, the output is disabled and the output voltage and current are zero. To enable the output, momentarily press OUT button.

5.2.6 Viewing Software Revision

Via the Front Panel Menu, it is possible view installed software revision.

1. Press MENU button. MENU (GREEN) LED illuminates. "SEt" message appears on the Voltage display.
2. Rotate Voltage Encoder until "inFo" message appears on Voltage Display.
3. Press Voltage Encoder. The "rEV" message appears on the display, and the installed software revision number appears on the Current display.

5.3 Alarms and Protective Functions

5.3.1 Introduction

There are several conditions that cause alarm (RED LED blinks). All alarms affect the output. When an alarm occurs, the respective fault will appear on the display and the alarm LED illuminates. It is possible that more than one fault (alarm) may be triggered but only the first will be shown on the display. If the second fault is still active when the first fault is removed, then the second fault will be displayed.
The following protective functions are incorporated in the power supply:

- OVP - Over Voltage Protection
- UVP - Under Voltage Protection
- ILC - Interlock
- FOLD - Fold Back Constant Current or Constant Voltage
- AC FAIL - AC Power shut down
- OTP - Over Temperature Protection

5.3.2 Over Voltage Protection

The OVP circuit protects the load in the event of a remote or local programming error or a power supply failure. The protection circuit monitors the voltage at the power supply sense points thus providing the protection level at the load. Upon detection of an Over Voltage condition, the power supply output will shut down.

5.3.2.1 Setting the OVP Level

The OVP can be set when the power supply output is Enabled (On) or Disabled (Off). The minimum setting level is 5% above the output voltage, or the value in Table 5-1, whichever is higher. The maximum setting level is shown in Table 5-1.

1. Press PROT button. PROT (GREEN) LED illuminates. "OUP" message appears on the Voltage display.
2. Press Voltage Encoder. "OUP" message appears on the Voltage display and the Current display shows OVP setting level.
3. Rotate the Current Encoder to adjust the OVP level.
4. Press PROT button twice or wait 15 sec. to return display to its previous state and then PREV LED turns OFF.

Model	Max. OVP	Min. OVP
10V	12.0V	0.5V
20V	24.0V	1.0V
36V	40.0V	2.0V
60V	66.0V	5.0V
100V	110.0V	5.0V

Table 5-1: Maximum/Minimum OVP setting levels

5.3.2.2 Resetting the OVP Circuit

To reset the OVP circuit after activation:

1. Reduce the power supply Output Voltage setting below the OVP set level.
2. Ensure that the load and the sense wiring is connected properly.
3. Four methods to reset the OVP circuit.
   - Press OUT button.
   - AC recycle.
   - On/Off recycle by analog control (Interlock).
   - Send communication command to enable output.

5.3.3 Under Voltage Protection and Under Voltage Limit

The UVP function prevents power supply operation if output voltage is below UVP set value. Upon detection of an Under Voltage condition, the power supply output will shut down. The UVL prevents adjustment of the output voltage below a certain limit. The combination of UVP/ UVL and OVP functions, allows the user to create a protection window for sensitive load circuitry.

5.3.3.1 Setting the UVP/UVL Mode and Level

The UVP/UVL can be set when the power supply output is Enabled (On) or Disabled (Off). UVL and UVP setting values are limited at the maximum level to approximately 5% below the Output Voltage setting. Attempting to adjust the value above this limit will result in no response to the adjustment attempt. The minimum value setting is zero.

1. Press PROT button. PROT (GREEN) LED illuminates. Current display shows "UUP" message.
2. Press Current Encoder. Voltage Display shows "UUP" or "UUL" message, Current display shows setting level.
3. Rotate the Voltage Encoder to set "UUP" or "UUL".
4. Rotate the Current Encoder to adjust the level.
5. Press PROT button twice or wait 15 sec. to return display to its previous state and then PREV LED turns OFF.

5.3.3.2 Activated UVP Alarm

When the UVP is activated the power supply output shuts down. The Voltage and Current display shows "UUP FAIL" and the ALARM RED LED blinks.

5.3.4 Foldback Protection

Foldback protection will shut down the power supply output if power supply operation mode crosses over from CC to CV or from CV to CC, according to selected operation mode. There are three states of foldback protection. OFF (default), CV, CC.

5.3.4.1 Setting the Foldback Protection

The Foldback can be set when the power supply output is Enabled (On) or Disabled (Off).

1. Press PROT button. PROT (GREEN) LED illuminates. The "OVP" message appears on the Voltage display.
2. Rotate Voltage Encoder until "FOLd" message appears on Voltage display.
3. Press Voltage Encoder. "FOLd" message appears on Voltage Display, and on Current display shows "OFF" or "CC" or "CV" setting mode.
4. Rotate the Current Encoder to adjust required mode and press to select. Display returns to the previous level.
5. Press PROT button to return display to its previous state (PROT LED turn OFF).

5.3.4.2 Activated FOLD Alarm

When the Foldback is activated the power supply output shuts off. The Voltage and Current display shows "FOLd FAIL" and the PROTECTION ALARM RED LED blinks.

5.3.5 Protection Delay

A delay can be set from between the time when a fault is detected and the output is disabled. It relates only in cases of UVP and Foldback protection.

NOTE:

UVP protection delay = 500ms + delay setting.

5.3.5.1 Setting the Protection Delay

1. Press PROT button. PROT (GREEN) LED illuminates. The "OVP" message, appears on the Voltage display.
2. Rotate Voltage Encoder until "Pr.dL" message appears on Voltage display, and then press the Encoder
3. The "Pr.dL" message appears on the Voltage Display. The Current display shows the value in seconds.
4. Rotate the Current Encoder to adjust the delay. Protection delay setting range is 0…25.5sec.
5. Press PROT button twice to return display to the previous state and PREV LED turns OFF.

5.3.6 Over Temperature Protection

The OTP circuit shuts down the power supply before the internal components can exceed their safe internal operating temperature. When an OTP shutdown occurs, the display shows "OtP FAIL" and the ALARM LED blinks. Resetting the OTP circuit can be automatic (non-latched) or manual (latched) depending on if he power supply is in Safe or Automatic restart mode.

- Safe start mode: The power supply stays off after the OTP condition has been removed. The display continue to shows "OtP FAIL" and the ALARM LED continues to blink. To reset the OTP circuit, press OUT button (or send Output Enable command).
- Auto-restart mode: The power supply recovers to it's last setting automatically after the OTP condition is removed.

5.3.7 AC Fail Alarm

The AC Fail alarm indicates whether the AC input has been discounted or shut down. When any of these faults occur, the display shows "AC FAIL". Output power is disabled, and the ALARM LED blinks.

- Safe start mode: The power supply returns to "OFF", after the AC power returns.
- Auto-restart mode: The power supply recovers to it's last setting automatically when AC power returns.

5.4 Series Operation

Power supplies of the same model can be connected in series to obtain increased output voltage. Split connection of the power supplies gives positive and negative output voltage.

5.4.1 Series Connection for Increased Output Voltage

Two units are connected so that their outputs are summed. Set the current limit of each power supply to the maximum that the load can handle without damage. It is recommended that diodes be connected in parallel with each unit output to prevent reverse voltage during start up sequence or in case one of the units shuts down. Each diode should be rated to at least the power supply rated output voltage and output current. Refer to Fig.5-1 and Fig.5-2 for series operation with local and remote sensing.

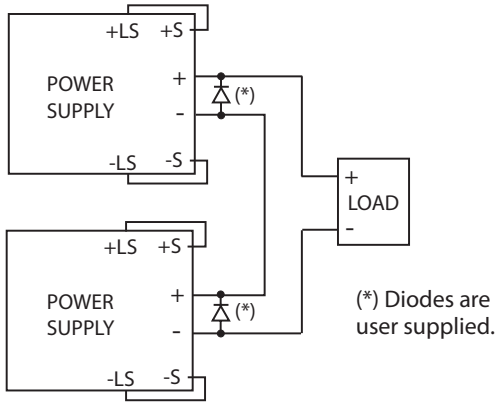


Fig.5-1: Series connection, local sensing

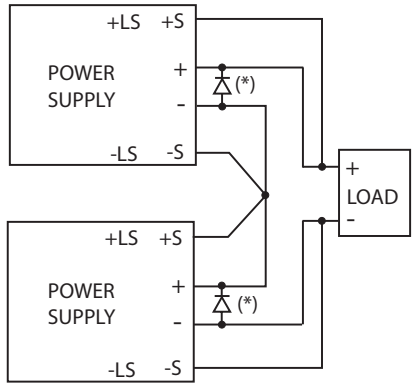


Fig.5-2: Series connection, remote sensing

5.4.2 Series Connection for Positive and Negative Output Voltage

In this mode, two units are configured as positive and negative output. Set the current limit of each power supply to the maximum that the load can handle without damage. It is recommended that diodes be connected in parallel with each unit output to prevent reverse voltage during start-up or in case one of the units shuts down. Each diode should be rated to at least the power supply rated output voltage and output current. Refer to Fig.5-3 for this operating mode.

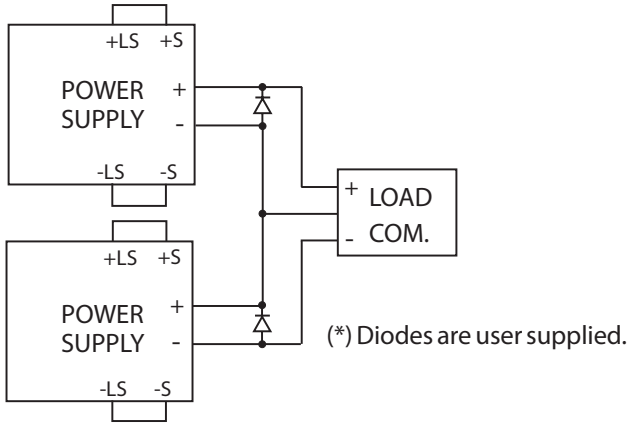


Fig.5-3: Series connection for positive/negative output voltages

5.4.3 Remote Programming in Series Operation

Programming by external voltage:	The analog programming circuits of this power supply are referenced to the negative Sense potential. Therefore, the circuits used to control each series connected unit must be separated and floated from each other. Refer to section 6.4
Using the SO function and PS_OK signal :	The Shut Off and PS_OK circuits are referenced to the isolated interface common, IF_COM (J3-7). The IF_COM terminals of the units can be connected to obtain a single control circuit for the power supplies connected in series.
Programming by external resistor :	Programming by external resistor is possible. Refer to section 6.5 for details.
Programming via the Serial Communication port (RS232/RS485, USB):	The Communication port is referenced to the IF_COM which is isolated from the power supply output potential. Therefore power supplies connected in series can be chained using the Remote-In and Remote-Out connectors. Refer to Chapter 7 for details.

5.5 Parallel Operation

5.5.1 Introduction

Up to six units of the same Voltage and Current rating can be connected in parallel to provide up to six times the output current capability. One of the units operates as a master and the remaining units are slaves. The slave units are analog programmed by the master unit. In remote digital operation, only the master unit can be programmed by the computer while the slave units may be connected to the computer for voltage, current and status readback only.

The Master and Slave modes are stored in the power supply EEPROM when the AC power is turned off. The system will return to the Master/Slave mode upon re-application of AC power.
There are two methods to configure multiple supplies for parallel operation (basic and advanced). Refer to Section 5.5.2 and to Section 5.5.3 for detailed explanation. Parallel modes are selected via Front Panel menu. Refer to table 5-2.

Subsystem Level		Function Level		Parameter Level	
Description	Display	Function	Display	Description	Display
Parallel Operating Mode	PrLL	Host /Basic Slave / Advanced Slave	HoSt	Master (Basic)	H1
				Master (Advanced)	H2..H6
			SLVE	Slave (Basic)	SL
				Slave (Advanced)	SLAd

Table 5-2. Parallel subsystem menu

Display	Operating Mode
H1	Single Supply (default)
H2	Master Supply with 1 Slave supply
H3	Master Supply with 2 Slave supply
H4	Master Supply with 3 Slave supply
H5	Master Supply with 4 Slave supply
H6	Master Supply with 5 Slave supply
S	Slave Supply

Table 5-2.1: Operation Setting Mode

5.5.2 Basic Parallel Operation

In this method, setting the units as Master and Slaves is made by the rear panel J1 connections and setup via Front Panel. Each unit displays its own output current and voltage. To program the load current, the Master unit should be programmed to the total load current divided by the number of units in the system. Refer to the following procedure to configure multiple supplies for simple parallel operation.

5.5.2.1 Master Unit Set Up

Set the master unit output voltage to the desired voltage. Program the current limit to the desired load current limit, divided by the number of parallel units. During operation, the master unit operates in CV mode, regulating the load voltage at the programmed output voltage. Connect the sensing circuit to local or remote sensing as shown in Fig.5-4 or Fig.5-5. Front Panel Main Menu Parallel mode is "H1" as default.

1. Press MENU button.
2. Rotate Voltage Encoder until "PrLL" appears on Voltage display, then press Voltage Encoder.
3. Rotate Current Encoder until "H1" appears.
4. Press Current Encoder to select "H1", the display blinks once and returns to previous menu level.

5.5.2.2 Slave Unit Set Up

When Slave mode is selected the power supply enters Current programming mode via external Voltage. Voltage and Current programming setting values are set to 105% of range. During operation the slave units operate as a controlled current source following the master output current. It is recommended that the power system is designed so that each unit supplies up to 95% of its current rating. This helps reduce imbalance which may occur by cabling and connections voltage drop.

1. Press MENU button
2. Rotate Voltage Encoder until "PrLL" appears on Voltage display, then press Voltage Encoder.
3. Rotate Current Encoder until "SL" appears.
4. Press Current Encoder to select "SL". Display blinks once and returns to previous display.
5. For wiring instructions, refer to Fig.5-4: Parallel connection with local sensing or Fig.5-5: Parallel connection with remote sensing.

5.5.2.3 Setting Over Voltage Protection

The master unit OVP should be programmed to the desired OVP level. In slave mode, the power supply is set to maximum as default.

5.5.2.4 Setting Foldback Protection

Foldback protection, if desired, may only be used with the master unit. When the master unit shuts down it programs the slave units to zero output voltage.

5.5.2.5 Connection to Load

In parallel operation, power supplies can be connected in local or remote sensing. Refer to Fig.5-4 and 5-5 for typical connections of parallel power supplies. The figures show connection of two units, however the same connection method applies for up to 6 units.

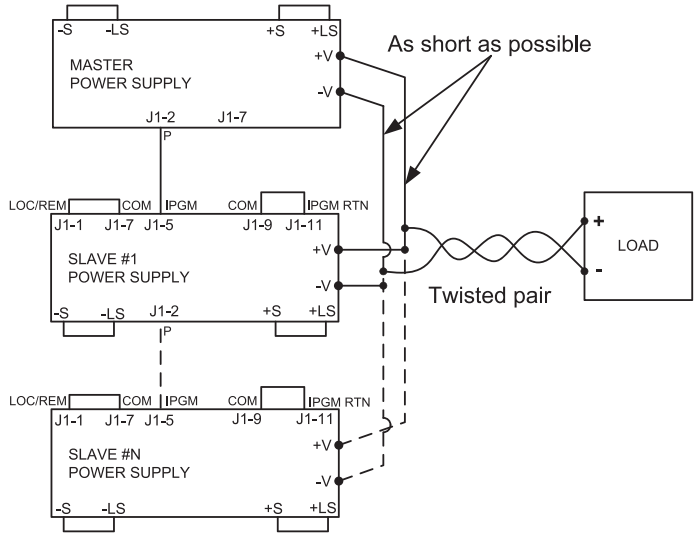


Fig.5-4: Parallel connection with local sensing

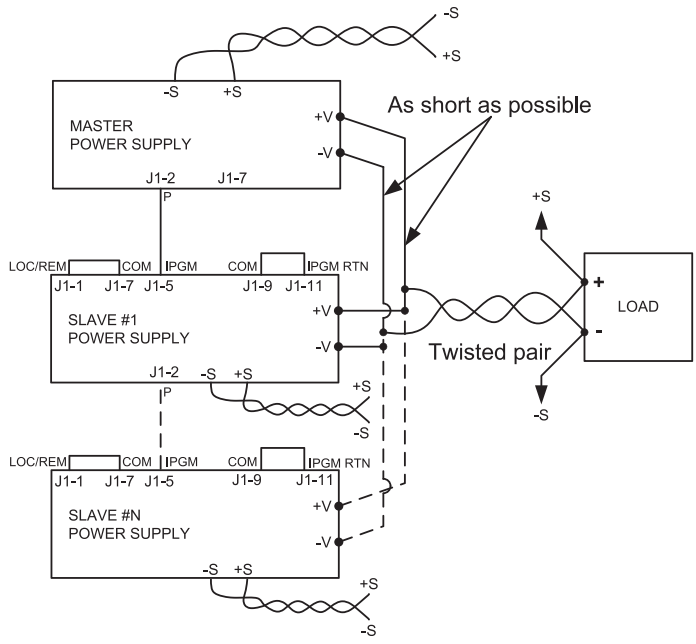


Fig.5-5: Parallel operation with Remote sensing

CAUTION:

Make sure that the connection between - Vo terminals is reliable to avoid disconnection during operation. Disconnection may cause damage to the power supply.

NOTE:

With local sensing it is important to minimize the wire length and resistance. Also the positive and negative wire resistance should be as close as possible to each other to achieve current balance between power supplies.

5.5.3 Advanced Parallel Operation

In Advanced Parallel operation the master unit displays the total current of all units connected in Parallel. The slave units display "On SLVE". The master and slave units operate in a Daisy-Chain connection configuration. For further details about Daisy-chain connection refer to section 5.6.

In the Advanced Parallel mode, the total current is programmed and reported by the master unit. The Current display accuracy is 2%+/- 1 count. In cases where higher accuracy is required, it is recommended to use Basic Parallel operation mode.

5.5.3.1 Setting Up of Master Unit

Set the master unit output voltage to the desired voltage. Program the current limit to the desired load current limit, divided by the number of parallel units. During operation, the master unit operates in CV mode, regulating the load voltage at the programmed output voltage. Connect the sensing circuit to local or remote sensing as shown in Fig.5-4 or Fig.5-5.

1. Press MENU button.
2. Rotate Voltage Encoder until "PrLL" appears on Voltage display, then press Voltage Encoder.
3. Rotate Current Encoder and select required 'n' value (from 2-6) for example, "H3". The display blinks once and returns to previous level. Refer to Table 5-2.1.
4. Recycle AC power.

5.5.3.2 Setting Up of Slave Units

When Advanced Slave mode is selected the power supply enters Current programming mode via external Voltage. Voltage and Current programming setting values are set to 105% of range. During operation the slave units operate as a controlled current source following the master output current. It is recommended that the power system is designed so that each unit supplies up to 95% of its current rating. This helps reduce imbalance which may occur by cabling and connections voltage drop.

When a unit is programmed to Advanced Slave mode it enters Remote mode with Local Lockout. In this mode, Front panel controls are disabled to prevent accidental setting change except Menu parallel setting and factory reset. Communication commands are disabled. Power supply responds only upon query.

1. Press MENU button.
2. Rotate Voltage Encoder until "PrLL" appears on Voltage display, then press Voltage Encoder.
3. Rotate Current Encoder until "SLAd" appears.
4. Press Current Encoder to select "SLAd". Display blinks once and returns to previous level.
5. Recycle AC power.
6. For wiring instructions, refer to Fig.5-4: Parallel connection with local sensing or Fig.5-5: Parallel connection with remote sensing and Section 5.6: Daisy-Chain connection.

NOTE:

To release units from Advanced mode select "H 1".

5.6 Daisy-Chain Connection

It is possible to configure a multiple power supply system to shut down all units when a fault condition occurs in one of the units. When the fault is removed, the system recovers according to a preset state: Safe start mode or Automatic restart.

Set signal "SO" to positive logic via Front panel (refer to section 5.7.1) . If a fault occurs in one of the units it's "PS_OK" signal will be set to low level and the display will indicate the fault. The other units will shut off and their displays will indicate "SO". When the fault condition is removed, the units will recover to their last setting according to their respective Safe start or Auto-restart setting.

Fig.5-6 shows connection of three units, however the same connection method applies to systems with more units.

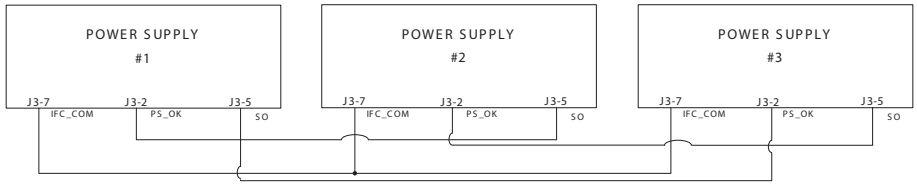


Fig.5-6: Daisy-Chain connection

5.7 Rear Panel (J3 Connector) Functions and Settings

Subsystem Level	Display	Function Level	Display	Parameter Level	Display	Description
Rear Panel	r.PAn	Interlock	ILC	Enable (ON)	On	Enable/Disable iner- lock function (Analog ON/OFF)
				Disable (OFF)	OFF	
		Shut OFF	SO	Positive	POS	Positive (polarity) same such PS_OK signal
				Negative	nEG	
		Programmed PIN 1	Pin1	High	Hi	Open collector
				Low	Lo	
		Programmed PIN 2	Pin2	High	Hi	Open collector
				Low	Lo	

Table 5-3: Rear panel subsystem menu

5.7.1 External Shut Off Function

SO signal serves as Output Shut Off . It is an optically isolated signal from the power supply output. Connection to the signal is made via pin J3-5 (Shut Off) and pin J3-7 (IFC_COM). The SO pin accepts a 2.5V to 15V signal or Open-Short contact to disable or enable the power supply output. The SO function will be activated only when a transition from On to Off is detected after applying AC power to the unit. Thus, in Auto start mode, the output will be enabled after applying AC power, even if SO is in Off level. After On to Off transition is detected, the SO will enable or disable the power supply output according to the signal level or the short/open applied to J3. When the external SO is triggered, the power supply will display "SO"on the voltage display but the ALARM LED will not illuminate.

The external shutdown is useful when using the power supply as part of a larger test system in which digital or analog control is required or in "Daisy-Chain".
The SO control logic can be selected via the Front panel as follows:

1. Press MENU button. MENU (GREEN) LED illuminates. "SEt" message appears on the Voltage display and "r.PAn" message appears on the Current display.
2. Press Current Encoder. The "SO" message appears on the Current display.
3. Press the Current Encoder again. The "SO" message appears on the Voltage display. Parameter "POS" or "nEG" appears on the Current display.
4. Rotate and press the Current Encoder to select the required parameter.
5. For signal details refer to Table 5-4.

SO logic	SO signal level J3-5 - J3-7)	Output status
Positive (as PS_OK) (default)	2-15V or Open 0-0.6V or Short	On Off SO
Negative	2-15V or Open 0-0.6V or Short	Off SO On

Table 5-4: SO logic selection

5.7.2 Interlock Function - Analog On/Off. (Enable/Disable)

Interlock signal serves as Output Enable/Disable via switch or relay. Use the Interlock function to enable or disable the output as emergency shutoff or door open switch. It is an optically isolated signal from the power supply output. Connection to the signal is made via pin J3-4 (ILC) and pin J3-7 (IFC_COM).

The ILC control logic can be selected via the Front panel as follows:

1. Press MENU button. MENU (GREEN) LED illuminates. "SEt" message appears on the Voltage display. "r.PAn" message appears on Current display.
2. Press Current Encoder and the "ILC" message appears on the display.
3. Press Voltage Encoder and "ILC" message appears on the display. The parameters "OFF" or "On" appear on the Current Encoder display.
4. Rotate and press the Current Encoder to select desired parameter.
5. For signal details refer to Table 5-5.

Front Panel ILC Setting	ILC Input	Power Supply Output	Display	Alarm LED
OFF - Default	Open or Short	On	Voltage/Current	Off
On	Open	Off	EnA	Blinking
	Short	On	Voltage/Current	Off

Table 5-5: Interlock functions and settings

CAUTION:

To prevent possible damage to the unit, do not connect any of the Enable /Disable inputs to the positive or negative output potential.

NOTE:

Safe Start mode - If the Interlock fault condition clears while units are in safe start mode, the power supply returns to Off mode.
Auto Restart mode - The output will automatically return to previous state.

5.7.3 Auxiliary Programmed Function Pin 1 and Pin 2

The programmed signal Pin 1 (J3-1) and Pin 2 (J3-6) are open collector, maximum input voltage 25V and maximum sink current 100mA, and can be controlled via Front panel or software.

Pin 1 or Pin 2 settings are made as follows:

1. Press MENU button. MENU (GREEN) LED illuminates. The "r.PAn" message appears on the Current display.
2. Press Current Encoder and the "ILC" message appears on the Voltage display.
3. Rotate Voltage Encoder until "Pin 1/Pin 2" message appears on display. Press Encoder to select the desired Pin.
4. Voltage display shows the selected Pin number.
5. Rotate the Current Encoder to toggle between "Hi" (High) or "Lo" (Low).
6. Press Current Encoder to select desired parameter.
7. Press MENU button twice to return display to it's previous state. MENU LED turns OFF.

CAUTION:

Do not connect Pin 1 and Pin 2 to a voltage source higher than 25V. Always connect Pin 1 and Pin 2 to the voltage source with a series resistor to limit the sink current to less than 100mA.

5.7.4 Power Supply OK Signal

PS_OK signal indicates fault condition in the power supply. It is a TTL signal output at J3-2, referenced to IF_COM at J3-7 (Isolated Interface Common). When a fault condition occurs, PS_OK level is low, with maximum sink current of 1mA. When no fault condition occurs, PS_OK level is high with maximum source current of 2mA. All conditions when output status is disabled sets PS_OK to low level.

The PS_OK signal at high level can be delayed via Front panel setting or software. This function is used to prevent signal rise before output reaches set value.

PS_OK delay setting is made as follows:

1. Press MENU button. MENU (GREEN) LED illuminates. The "r.PAn" message appears on the Current display.
2. Press Current Encoder, "ILC" message appears on the Voltage Display.
3. Rotate Voltage Encoder until "PSd" message appears and press Encoder.
4. Parameter delay time in mSec appears on the Current display
5. Rotate the Current Encoder to adjust the setting level. PS_OK delay range is from 0…9999mSec.
6. Press MENU button twice to return display to it's previous state. MENU LED turns OFF.

5.8 Rear Panel (J1 Connector) Functions

5.8.1 CV/CC Signal

The CV/CC signal indicates the operating mode of the power supply. Constant Voltage or Constant Current. CV/CC signal is an open collector output with a 30V parallel zener, at J1-8, referenced to the COM at J1-7 (connected internally to the negative sense potential). When the power supply operates in Constant Voltage mode, CV/CC output is open. When the power supply operates in Constant Current mode, CV/CC signal output is low (0-0.6), with maximum 10mA sink current.

CAUTION:

Do not connect CV/CC signal to a voltage source higher than 30VDC. Always connect CV/CC signal to the voltage source with a series resistor to limit the sink current to less than 10mA.

5.9 Parameter Setting Memory

Power Supply has four memory configuration modes:

Subsystem Level	Display	Function Level	Display	Parameter Level	Display	Description
Memory	mEmo	SAVE	SAVE	1…4	1...4	Save setting in non violate memory
		RECALL	rECL	1…4	1...4	Recall setting in non violate memory
		RST	rSt	YES	YES	Reset setting
		FRST	F.rSt	YES	YES	Set factory default setting

Table 5-6: Parameter Setting Memory

5.9.1 Default Setting

For factory default parameters refer to Table 5-7.

1. Press MENU button. MENU (green) LED illuminates. "SEt" message appears on the Voltage display.
2. Rotate Voltage Encoder until "mEmO" message appears on Voltage display.
3. Press Voltage Encoder. "SAVE" message appears on Voltage Display.
4. Rotate Voltage Encoder until "F.rSt" message appears on Voltage display.
5. Press Voltage Encoder. "F.rSt" message appears on Voltage Display, and "YES" appears on Current display .
6. Press the Current Encoder "HOLd" Message appears on the display for 1sec. The display blinks once and returns to previous level.
7. Press MENU button twice to return display to previous state, MENU LED turns OFF.

NOTE:

No response for FRST command. After this command the power supply loses communication because of communication setting change.

5.9.2 Reset.

For Reset parameters refer to Table 5-7.

1. Press MENU button. MENU (green) LED illuminates. "SEt" message appears on the Voltage display.
2. Rotate Voltage Encoder until "mEmO" message appears on Voltage display.
3. Press Voltage Encoder. "SAVE" message appears on Voltage Display.
4. Rotate Voltage Encoder until "rSt" message appears on Voltage display.
5. Press Voltage Encoder. "rSt" message appears on Voltage Display. "YES" appears on the Current display .
6. Press the Current Encoder, display blinks and returns to previous level.
7. Press MENU button twice to return display to previous state, MENU LED turns OFF.

5.9.3 Last Setting Memory

Memory stores last set parameters when AC switch is turned off.
For last set parameters refer to Table 5-7.

5.9.4 Save

This command saves the present state of the power supply to a specified location in memory. Up to 4 states can be stored. Storage locations 1 through 4 are in nonvolatile memory.

Save Front panel setting:

1. Press MENU button. MENU (green) LED illuminates. "SEt" message appears on the Voltage display.
2. Rotate Voltage Encoder until "MEMO" message appears on Voltage display.
3. Press Voltage Encoder. "SAVE" message appears on Voltage display.
4. Press Voltage Encoder. "SAVE" message appears on Voltage display. Numbers "1..4" appear on Current display.
5. Rotate the Current Encoder to select required number value and then press the Current Encoder. Display blinks and returns to previous level.

5.9.5 Recall

This command recalls the present state of the power supply from a specified location in memory. Up to 4 states can be stored. Storage locations 1 through 4 are in nonvolatile memory.

Recall front panel setting:

1. Press MENU button. MENU (green) LED illuminates. "SEt" message appears on the Voltage display.
2. Rotate the Voltage Encoder until "MEMO" message appears on Voltage display.
3. Press Voltage Encoder. "rECL" message appears on Current Display.
4. Numbers "1..4" appear on Current display.
5. Rotate the Current Encoder to select required number value and then press the Current Encoder. Display blinks and returns to previous level.

Parameter	Factory Default	Resetting	Last setting	Save & Recall
Output Status	OFF	OFF	+	+
Voltage Set-point	0V	0V	+	+
Current Set-point	MAX	0A	+	+
Fold Back mode	OFF	OFF	+	+
Over Voltage Protection OVP	MAX	MAX	+	+
Under Voltage Level/ Protection mode	OFF (UVL)	OFF (UVL)	+	+
Under Voltage Level/ Protection level	0V	0V	+	+
Auto Start Mode	SAFE	SAFE	+	+
Control pin 1	High	High	+	+
Control pin 2	High	High	+	+
Input Trigger Source	EXT	EXT	+	-
Protection Delay	0mS	0mS	+	+
Parameter	Factory Default	Resetting	Last Setting	Save & Recall
Voltage Programming Mode	Digital	-	+	-
Current Programming Mode	Digital	-	+	-
Programming and Monitor Range	5V	-	+	-
Current Share Mode {Master|Slave}	(Master H1)	-	+	-
Interlock (PROTote Inhibit)	OFF (disabled)	OFF (disabled)	+	-
Shutdown Logic	1 (positive)	-	+	-
Remote mode	LOC	LOC	+	+
Communication Mode	RS232	-	+	-
Address	6	-	+	-
Baud Rate	9600	-	+	-
Language	SCPI	-	+	-
Lock/unlock front panel	Unlock	-	+	-
LIST and WAVE subsystems	OFF	OFF	-	-
Program Step	AUTO	-	-	-
Trigger Out	OFF	OFF	+	+
PS_OK delay	0mS	0mS	+	+
Special Voltage Under limit SVUL	Rated	-	+	-
Special Current Under limit SCUL	Rated	-	+	-
Enable registers	Clear	Clear	-	-
Event registers	Clear	Clear	-	-

Table 5-7: Memory parameters.

CHAPTER 6: REMOTE ANALOG PROGRAMMING

6.1 Introduction

The Rear Panel connector J1 allows the user to program the power supply output voltage and current limit with an analog device. J1 also provides monitoring signals for output voltage and output current. The programming range and monitoring signals range can be selected between 0-5V or 0-10V using the Front Panel Menu Subsystem Level.

Subsystem Level	Display	Function Level	Display	Parameter Level	Display	Description
SET	SEt	Voltage limit source	VOLt	Front Panel (Digital)	F.PAn	Parameter settings in Analog/ Digital control mode, Voltage channel.
				Ext. Voltage	E.VOL	
				Ext. Resist.	E.rES	
		Current limit source	Curr	Front Panel (Digital)	F.PAn	Parameter settings in Analog/ Digital control mode, Current channel.
				Ext. Voltage	E.VOL	
				Ext. Resist.	E.rES	
		Source and monitor range	rAnG	5/10 (V/KΩ) range	5	Control by external Voltage/ Resistor, Range 5/10

Table 6-1: MENU. Analog Programming Setting

CAUTION:

COM (J1-7,9) and VPGM_RTN (J1-12) terminals of J1 connect internally to the -Sense potential (-S). Do not connect these terminals to any potential other than -Sense (-S), as it may damage the power supply.

6.2 Local/Remote Analog Control

Contact J1-1 (Fig.4-3, item 1) accepts TTL signal or Open-Short contact (Referenced to J1-7,9) to select between Local or Remote Analog programming of the output voltage and current limit. In Local mode, the output voltage and current limit can be programmed via the front panel Voltage and Current Encoders or via the Communication interface. In Remote Analog mode, the output voltage and current limit can be programmed by analog voltage or by programming resistors via J1 contacts 6 and 5. Refer to Analog Programming Setting Table 6-2.

6.3 Local/Remote Analog Indication

Contact J1-4 (Fig.4-3, item 4) is an open collector output that indicates if the power supply is in Local mode or in Remote Analog mode. To use this output, connect a pull-up resistor to a voltage source of 30Vdc maximum. Choose the pull-up resistor so that the sink current will be less than 5mA when the output is in low state. J1-4 signal will be low if J1-1 is low and at least one of Analog control modes are selected. Refer to Analog Programming Setting Table 6-2.

J1-1 LOC/REM SELECT	Front Panel selection	Front Panel selection	J1-4 LOC/REM MON
OPEN "1"	Not applicable	Not applicable	Open
TTL "0" or Short	F.PAn	F.PAn	Open
	E.VOL or E.rES	F.PAn	0~0.6V
	F.PAn	E.VOL or E.rES	0~0.6V
	E.VOL or E.rES	E.VOL or E.rES	0~0.6V

Table 6-2: Local/Remote Analog Control and Indication

6.4 Remote Voltage Programming of Output Voltage and Current

Remote Programming settings are as follows:

1. For Voltage Analog Programming wiring refer to Fig.6-1.
2. Short pins J1-1 to J1-7.
3. Press MENU button. MENU (GREEN) LED illuminates. "SEt" message appears on Voltage display.
4. Press Voltage Encoder. "UOLt" message appears on Voltage Display and "Curr" appears on the current display.
5. Press Voltage Encoder to select programming of the Output Voltage, or press Current Encoder to select programming of the Output Current.
6. The selected function appears on the Voltage display. Parameter "F.PAn" or "E.UOL" or "E.rES" appears on the Current display.
7. Rotate and press the Current Encoder to select "E.UOL".
8. "UOLt" message appears on Voltage Display and "Curr" appears on the Current display.
9. Rotate Voltage Encoder until "rAnG" appears on display. Press on the relevant Encoder.
10. "rAnG" appears on Voltage display and "5" (5V) or "10" (10V) appears on Current display.
11. Rotate and press the Current Encoder to select the desired programming Voltage range.
12. Press MENU button twice to return display to it's previous state. MENU LED turns OFF

CAUTION:

To maintain the isolation of power supply and prevent ground loops, use an isolated programming source when operating the power supply via remote analog programming at J1 connector.

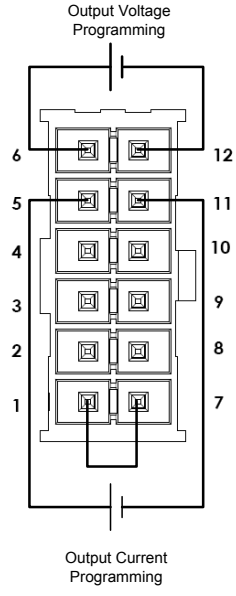


Fig.6-1: J1-Remote Voltage Programming Connection

6.5 Remote Resistor Programming of Output Voltage and Output Current

For resistive programming, internal current sources, for output voltage and/or output current control, supply 1mA current through external programming resistors connected between J1-6 & J1-12 and J1-5 & J1-11, J7 . The voltage across the programming resistors is used as a programming voltage for the power supply. Resistance of 0~5Kohm or 0~10Kohm can be selected to program the output voltage and current limit from zero to full scale. A variable resistor can control the output over the entire range, or a combination of variable resistors and series/parallel resistors can control the output over restricted portion of the range.

Remote Programming settings as follows:

1. For Resistor Analog Programming wiring refer to Fig.6-2.
2. Short pins J1-1 to J1-7.
3. Press MENU button. MENU (GREEN) LED illuminates. "SEt" message appears on Voltage display.
4. Press Voltage Encoder. "UOLt" message appears on Voltage Display and "Curr" appears on the current display.
5. Press on the Voltage Encoder to select programming the Output Voltage, or Press Current Encoder to select programming of the Output Current.
6. The selected function appears on the Voltage display. Parameter "F.PAn" or "E.UOL" or "E.rES" appears on the Current display.
7. Rotate and press the Current Encoder on to select "E.rES".
8. "UOLt" message appears on Voltage Display and "Curr" appears on the current display.
9. Rotate Current Encoder until "rAnG" appears on the display. Press on the relevant Encoder.
10. "rAnG" appears on Voltage display and "5" (5K) or "10" (10K) appears on Current display.
11. Rotate and press the Current Encoder to select the desired programming Voltage range.
12. Press MENU button twice to return display to the previous state. MENU LED turns OFF.

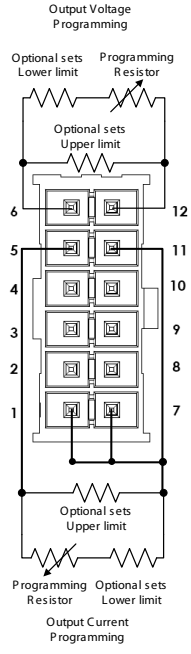


Fig.6-2: J1-Remote Resistor Programming Connection

NOTES:

1. In Remote analog mode: the output voltage cannot be set by the VOLTAGE Encoder. The output voltage limit is set to 5% over the model-rated maximum value. The output Current limit is set by the Current encoder to 5% over the model-rated maximum value.
2. The power supply will operate within the extended range, however it is not recommended to operate the power supply over its voltage and current rating and performance is not guaranteed.
3. Communication: In Remote analog mode, power supply parameters can be programmed and read back via the Communication port except output voltage and current settings.
4. To maintain the temperature stability specification of the power supply, the resistors used for programming should be stable and low noise resistors, with a temperature coefficient of less than 50ppm.
5. Radiated emissions, FCC requirements: FCC requirements for radiated emissions, use a shielded cable for the analog control signals. In cases using a non shielded cable, attach an EMI ferrite suppressor to the cable, as close as possible to the power supply.
6. Front panel PREV button: Use PREV button to display the output voltage and current settings defined by the Encoders or Communication.

6.6 Programming Monitoring of Output Voltage (V_MON) and Current (I_MON)

The J1 connector, located on the rear panel provides analog signals for monitoring the output voltage and output current. Selection of the voltage range between 0-5V or 0-10V is made via Front Panel.

The monitoring signals represent 0 to 100% of the power supply output voltage and output current. The monitor outputs have 500 ohm series output resistance.

Ensure that the sensing circuit has an input resistance of greater than 500 Kohm or accuracy will be reduced.

Range selection as follows:

1. Press MENU button. MENU (GREEN) LED illuminates. "SEt" appears on Voltage display.
2. Press Voltage Encoder. "UOLt" message appears on Voltage Display and "Curr" appears on the current display.
3. Rotate Voltage Encoder until "rAnG" appears on display. Press on the relevant Encoder.
4. "rAnG" appears on Voltage display and "5" (5K) or "10" (10K) appears on Current display.
5. Rotate and press the Current Encoder to select the desired programming Voltage range.
6. Press MENU button twice to return display to the previous state. MENU LED turns OFF.

CHAPTER 7: Serial RS232/RS485 and USB Interface

7.1 Introduction

This chapter describes the set-up, operation, commands and communication protocol of Z+ power supplies via serial communication interfaces: RS232, RS485 or USB.

7.2 Configuration

Function Level	Display	Parameter Level	Display		Description
Interface	InTF	232	232		
		485	485		
		USb	USb		
		LAn	LAn		Available only if IEEE or LAN option installed
		IEEE	IEEE		
Address	Adr	1….31	1...31		
Baud Rate	bAUd	1200..57600	57.6		
Language	LAnG	SCPI	SCPI		
		GEN	GEn		
IP Address	IP	IP1---IP4	IP 2	1096	Available only if LAN option installed
MAC Address	nAC	MAC1-MAC6	nAC6	3345	
LAN Reset	LrSt	Yes	YES		

Table 7-1: Front panel setup

7.2.1 Default Setting

Refer to Table 5-9: Memory parameters.

7.2.2 Address Setting

The power supply address can be set to any address between 1 and 31.

1. Press REM button. The REM LED illuminates. "Adr" message appears on the Current display.
2. Press Current Encoder. Voltage display shows "Adr" and Current display shows present address.
3. Rotate the Current Encoder to select required address.
4. Press Current Encoder to enter selected parameter to memory.
5. When parameter is accepted the display blinks once and returns to the previous level.

7.2.3 Communication Interface Selection

Z+ power supply can be configured for RS232, RS485 or USB communication interface.

1. Press REM button. The REM LED illuminates. "InTF" message appears on the Voltage display.
2. Press Voltage Encoder. Voltage display shows "InTF" and Current display shows communication interface.
3. Rotate the Current Encoder to select the required interface.
4. Press Current Encoder to enter selected parameter to memory.
5. When parameter is accepted the display blinks once and returns to the previous level.

7.2.4 Baud Rate Setting

Seven optional rates are possible: 1200, 2400, 4800, 9600, 19200, 38400, 57600.

1. Press REM button. The REM LED illuminates. "InTF" message appears on the Voltage display.
2. Rotate Voltage Encoder until Voltage display shows "bAUd".
3. Press Voltage Encoder. Voltage display shows "bAUd" and Current display shows baud rate.
3. Rotate the Current Encoder to select required baud rate.
4. Press Current Encoder to enter selected parameter to memory.
5. When parameter is accepted the display blinks once and returns to the previous level.

7.2.5 Language Selection (RS232/RS485, USB)

The Z+ implements SCPI standard command line interface to remotely control the power supply. Additionally, a small subset of legacy GEN commands has been provided for ease of use and backwards compatibility.

1 Press REM button. The REM LED illuminates. "InTF" message appears on the Voltage display.
2. Rotate Voltage Encoder until Voltage display shows "LAnG".
3. Press Voltage Encoder. Voltage display shows "LAnG" and Current display shows language.
3. Rotate the Current Encoder to select required language.
4. Press Current Encoder to enter selected parameter to memory.
5. When parameter is accepted the display blinks once and returns to the previous level.

7.2.6 Setting Unit in Remote, Local Lockout or Local Mode

Local mode:

When the power supply is in local mode, it can receive queries. If a query is received, the power supply will reply and remain in Local mode. Serial commands may be sent to set and read the status registers while the unit is in Local mode. If the Enable registers are set the power supply will transmit SRQ's while in Local mode. (refer to section 7.8.5 and section 7.12)

Remote mode:

If a command is received that affects the output or a Remote command is received, the power supply will perform the command and change to Remote mode.
Set Remote command:

- GEN Language: RMT 1.
- SCPI Language: SYSTem:REMote[:STAte] REM/1.

When the power supply is in Remote mode, LED REM illuminates, Front Panel is in preview mode, and parameters cannot be changed. Return to Local mode via the front panel REM/LOC Button or via serial port command.
Return to Local command:

- GEN Language: RMT 0.
- SCPI Language: SYSTem:REMote[:STAte] LOC/0.

Local Lockout mode:

When the power supply is in Local Lockout mode, LED REM illuminates, Front Panel is in preview mode, and parameters cannot be changed. Return to Remote mode via the serial port command or by turning Off the AC power until the display turns off. Then turn On AC power again.
Set to Local Lockout command:

- GEN Language: RMT 2.
- SCPI Language: SYSTem:REMote[:STAte] LLO/2

7.3 Rear Panel RS232/485 Connector

The RS232/485 interface is accessible through the Rear panel RS232/485 IN and RS485 OUT connectors. The connectors are 8 contact RJ-45. The IN and OUT connectors are used to connect power supplies in a RS232 or RS485 chain to a controller. Refer to Fig.7-1 for IN/OUT connectors.

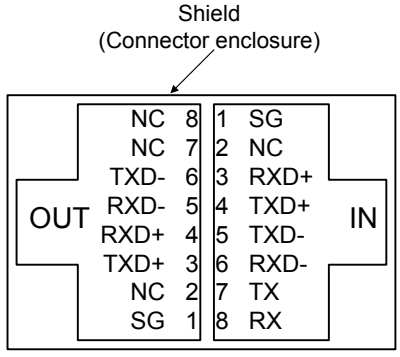


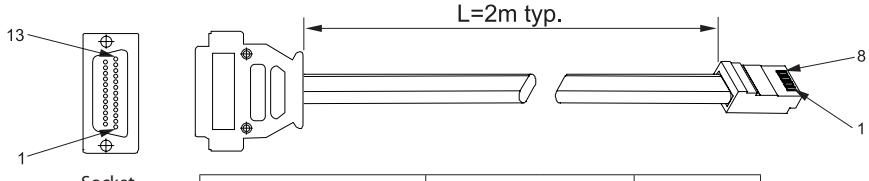
Fig.7-1: J4 rear panel IN/OUT connectors pinout

NOTE:

Tx and Rx are used for RS232 communication. Txd +/- and Rxd +/- are used for RS485 communication. Refer to RS232 and RS485 cable descriptions for connection details.

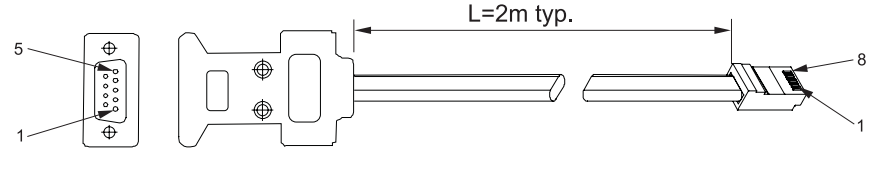
7.4 Connectig Power Supply To RS232 Or RS485 BUS

Connect rear panel IN connector to the controller RS232 or RS485 port using a suitable shielded cable. Refer to Figures 7-2, 7-3 and 7-4 for available RS232 and RS485 cables.



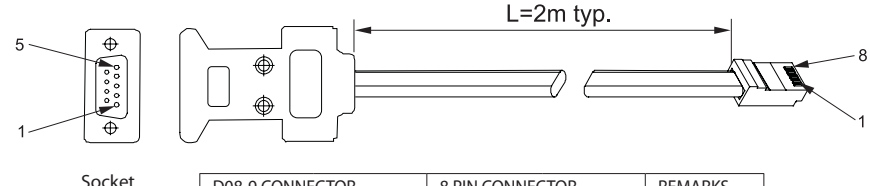
08-25 CONNECTOR		8 PIN CONNECTOR		REMARKS
PIN NO.	NAME	PIN NO.	NAME	
1	SHIELD	HOUSING	SHIELD	
2	TX	8	RX	TWISTED
3	RX	7	TX	PAIR
7	SG	1	SG	

Fig.7-2: RS232 cable with DB25 connector (P/N: Z/232-25)



D08-9 CONNECTOR		8 PIN CONNECTOR		REMARKS
PIN NO.	NAME	PIN NO.	NAME	
HOUSING	SHIELD	HOUSING	SHIELD	
2	RX	7	TX	TWISTED
3	TX	8	RX	PAIR
5	SG	1	SG	

Fig.7-3: RS232 cable with DB9 connector (P/N: Z/232-9)



D08-9 CONNECTOR		8 PIN CONNECTOR		REMARKS
PIN NO.	NAME	PIN NO.	NAME	
HOUSING	SHIELD	HOUSING	SHIELD	
9	TXD-	6	RXD-	TWISTED
8	TXD+	3	RXD+	PAIR
1	SG	1	SG	
5	RXD-	5	TXD-	TWISTED
4	RXD+	4	TXD+	PAIR

Fig.7-4: RS485 cable with DB9 connector (P/N: Z/485-9)

7.5 Rear Panel USB Connector

A standard USB Series B device connector is located on Rear panel for USB control. Refer to Fig.7-5 and Table 7-2.

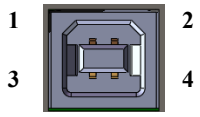
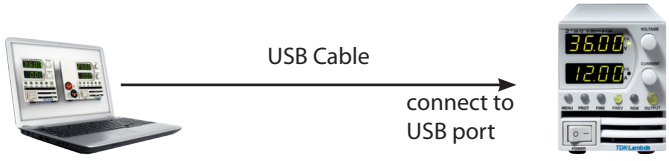


Fig.7-5: USB Connector

Pin	Designator	Description
1	VBUS	+3.3 VDC
2	D-	Data -
3	D+	Data +
4	GND	Interface com

Table 7-2: USB connector pin out

7.5.1 USB Getting Started



The following steps will help you quickly get started connecting your USB-enabled instrument to the Universal Serial Bus (USB):

1. Connect Z+ to the USB port on the computer.
2. Insert the software CD-ROM that is shipped with the product to your CD-ROM Drive
   The Z+ drivers selection menu will automatically appears. click on the ICON "USB drivers"
   Install the USB Driver.

7.6 Multi Power Supply Connection to RS232 Or RS485 or USB

A Daisy-chain configuration of up to 31 units can be connected to RS232, RS485 or USB . The first unit connects to the controller via RS232, RS485 or USB and other units are connected with a RS485 bus. The user must set all slave power supplies to a unique address. No two power supplies may have the same address.

1. First unit connection: Select communication Interface. Refer to section 7.2.3.
2. Other unit connections: The other units on the bus are connected via their RS485 interface. Refer to Figures 7-6 and 7-7 for typical connections.
3. Using the Linking cable supplied with each unit (Refer to Fig.7-8), connect each unit OUT connector to the next unit IN connector.

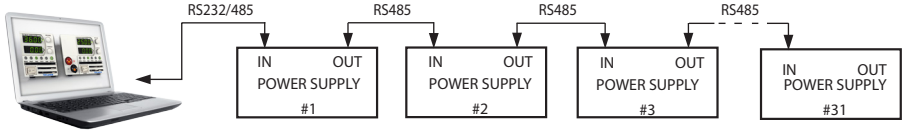


Fig.7-6: Multi power supplies RS232/485 connection

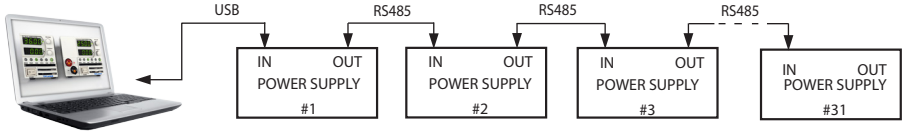
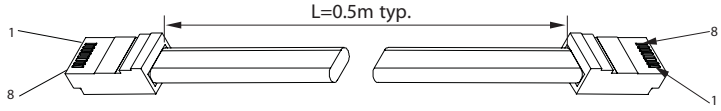


Fig.7-7: Multi power supplies USB connection

NOTES:

It is recommended when using ten or more power supplies in Daisy-chain system to connect 120Ω resistive termination at the last unit's RS-485 out connector
120Ω, 0.5W between TXD+ and TXD-.
120Ω, 0.5W between RXD+ and RXD-.



8 PIN CONNECTOR (IN)		8 PIN CONNECTOR (OUT)	
PIN NO.	NAME	PIN NO.	NAME
HOUSING	SHIELD	HOUSING	SHIELD
1	SG	1	SG
6	TXD-	6	RXD-
3	TXD+	3	RXD+
5	RXD-	5	TXD-
4	RXD+	4	TXD+

Fig.7-8: Serial link cable with RJ-45 shielded connectors (P/N: Z/RJ45)

7.7 GEN Protocol (GEN series communication language)

NOTE:

The address (ADR n) command must return an "OK" response before any other commands are accepted.

7.7.1 Data Format

Serial data format is 8 bit, one start bit and one stop bit. No parity bit.

7.7.2 End of Message

The end of message is the Carriage Return character (ASCII 13, 0x0D). The power supply ignores the Line Feed (ASCII 10, 0x0A) character.

7.7.3 Command Repeat

The backslash character "\" will cause the last command to be repeated.

7.7.4 Checksum

The user may optionally add a checksum to the end of the command. The checksum is "$" followed by two hex characters. If a command or a query has checksum, the response will also have one. There is no CR between the command string and the "$" sign. Example: STT?$3A STAT?$7B

7.7.5 Acknowledge

The power supply acknowledges received commands by returning "OK" message. If an error is detected, the power supply will return an error message. The rules for checksum also apply to the acknowledge feature.

7.7.6 Backspace

The backspace character (ASCII 8) clears the last character sent to the power supply.

7.7.7 Error Messages

The power supply will return error messages for illegal commands and illegal programming parameters. Refer to Table 7-3 for programming error messages and Table 7-4 for command error messages.

Error Code	Description
E01	Returned when program voltage (PV) is programmed above acceptable range. Example: PV value is above '105% of supply rating' or 'PV above 95% of OVP setting'.
E02	Returned when programming output voltage below UVL setting.
E04	Returned when OVP is programmed below acceptable range. Example: OVP value is less than '5% of supply voltage rating' plus 'voltage setting'.
E06	Returned when UVL value is programmed above the programmed output voltage.
E07	Returned when programming the Output to ON during a fault shut down.
E08	Cannot execute command via Parallel ADSN mode.

Table 7-3: Programming error messages

Error Code	Description
C01	Illegal command or query
C02	Missing parameter
C03	Illegal parameter
C04	Checksum error
C05	Setting out of range

Table 7-4: Commands error messages

7.8 GEN Command Set Description

7.8.1 General guides

1. Any command or argument may be in capital letters or small letters.
2. In commands with an argument, a space must appear between the command and the argument.
3. For any command that sets a numeric value, the value may be up to 12 characters long.
4. Carriage Return: If the CR character (ASCII 13) is received by itself, the power supply will respond with "OK" and CR.

7.8.2 Command Set Categories

The command set is divided into four categories as follows:

1. Identification Commands
2. Initialization Commands
3. Output Commands
4. Global Commands
5. Auxiliary Commands
6. Status Commands

7.8.3 Identification Commands

IDN?	Returns the power supply model identification as an ASCII string: Default: "TDK-Lambda,ZX-Y" (one comma, no spaces) X = rated output voltage Y = rated output current
REV?	Returns the software version as an ASCII string. Current rev: "REV:1.0"
SN?	Return power supply serial number. Up to 12 characters in any format.
DATE?	Returns date of last calibration. Format "yyyy/mm/dd". Example "2009/12/17"

7.8.4 Initialization Commands

Command	Description
ADR n	ADR is followed by address which can be 1 to 31 and is used to access the power supply .
CLS	Clear status. Sets FEVE and SEVE registers to zero (Refer to section 7.11).
RST	Reset command. Brings the power supply to a safe and known state: Output voltage: zero, Remote: non-latched remote, Output current: zero, Auto-start: Off, Output: Off, OVP: maximum, FOLD: Off, UVL: zero The conditional registers (FLT and STAT) are updated, the other registers are not changed.
RMT	Sets the power supply to local or remote mode: 1. RMT 0 or RMT LOC, sets the power supply to Local mode. 2. RMT 1 or RMT REM, sets the unit to remote mode. 3. RMT 2 or RMT LLO, sets the unit to Local Lockout mode (latched remote mode).
RMT?	Returns the Remote mode setting: 1. "LOC"- The unit is in Local mode. 2. "REM"- The unit is in Remote mode. 3. "LLO"- The unit is in Local Lockout (latched remote) mode.
MDAV?	Returns MD MODE OPTION Status. 1 indicates installed and 0 indicates not installed.
\	Repeat last command. If \<CR> is received, the power supply will repeat the last command.

7.8.5 Output Commands

Command	Description
PV n	Sets the output voltage value in Volts. The range of voltage value is described in Table 7-3. The maximum number of characters is 12. See the following examples for PV n format: PV 12, PV 012, PV 12.0, PV 012.00, etc...
PV?	Reads the output voltage setting. Returns the string "n" where "n" is the exact string sent in the PV n command. When in Local mode, returns the PREVIEW (front panel) settings in a 5 digit string.
MV?	Reads the actual output voltage. Return 5 digit string. Example: 60V supply sends 01.150, 15.012, 50.000, etc...
PC n (See Note 1)	Sets the output current value in Amperes. The range of current values are described in Table 7-4 and 7-5. The maximum number of characters is 12. See the following examples for PC n format: PC 10, PC 10.0, PC 010.00, etc...
PC?	Reads the output current setting. Returns the string "n" where "n" is the exact string sent in the PC n command. When in Local mode, returns the PREVIEW (front panel) settings in a 5 digit string.
MC? (See Note 2)	Reads the actual output current. Returns 5 digit string. Example: 200A supply sends 000.50, 110.12, 200.00, etc...
DVC?	Display Voltage and Current data. Data will be returned as a string of ASCII characters. A comma will separate the different fields. The fields, in order, are: Measured Voltage, Programmed Voltage, Measured Current, Programmed Current, Over Voltage Set point and Under Voltage Set Point. Example: 5.9999, 6.0000, 010.02, 010.00, 7.500, 0.000

Command	Description
OUT n	Turns the output to ON or OFF. Recover from Safe-Start, OVP or FLD fault. OUT 1 (or OUT ON)-Turn On.
OUT?	Returns the output On/Off status string. ON- output on. OFF- output off.
FLD n	Sets the Foldback protection to ON or OFF. FLD 1 (or FOLD ON) - Arms the Foldback protection. FLD 0 (or FOLD OFF)- Cancels the Foldback protection. When the Foldback protection has been activated, OUT 1 command will release the protection and re-arm it, while FLD 0 will cancel the protection.
FLD?	Returns the Foldback protection status string: "ON"- Foldback is armed, "OFF"- Foldback is canceled.
FBD nn	Add (nn x 0.1) seconds to the Fold Back Delay. This delay is in addition to the standard delay. The range of nn is 0 to 255. The value is stored in eprom at AC power and recovered at AC power up.
FBD?	Supply returns the value of the added Fold Back Delay.
FBDRST	Reset the added Fold Back Delay to zero.
OVP n	Sets the OVP level. The OVP setting range is given in Table 7-8. The number of characters after OVP is up to 12. The minimum setting level is approx. 105% of the set output voltage, or the value in Table 7-8, whichever is higher. Attempting to program the OVP below this level will result in execution error response ("E04"). The OVP setting stays unchanged.
OVP?	Returns the setting "n" where "n" is the exact string in the user's "OVP n". When in Local mode, returns the last setting from the front panel in a 4 digit string.
OVM	Sets OVP level to the maximum level. Refer to Table 7-8.
UVL n	Sets Under Voltage Limit. Maximum value of "n" is 5% below PV setting, but returns "E06" if higher. Refer to Table 7-9 for UVL programming range.
UVL?	Returns the setting "n" where "n" is the exact string in the user's "UVL n". When in Local mode, returns the last setting from the front panel in a 4 digit string. When UVP is activated, returns the setting
UVP n	Sets Under Voltage Protection. Maximum value of "n" is 5% below PV setting, but returns "E06" if higher. Refer to Table 7-9 for UVP programming range.
UVP?	Returns the setting "n" where "n" is the exact string in the user's "UVP n". When in Local mode, returns the last setting from the front panel in a 4 digit string.
AST n	Sets the auto-restart mode to ON or OFF. AST 1 (or AST ON)- Auto restart on. AST 0 (or AST OFF)- Auto restart off.
AST?	Returns the string auto-restart mode status.
SAV	Saves present settings. The settings are the same as power-down last settings. These settings are erased when the supply power is switched off and the new "last settings" are saved.
RCL	Recalls last settings. Settings are from the last power-down or from the last "SAV" command.
MODE?	Returns the power supply operation mode. When the power supply is On (OUT 1) it will return "CV" or "CC". When the power supply is OFF (OUT 0) it will return "OFF".
MS?	Returns the Master/Slave setting. Master: n = 1..... 6 Slave: n = 0

NOTES:

1. In Advanced Parallel mode (Refer to Sec. 5.5.3.1), "n" is the total system current.
2. In Advanced Parallel mode, "MC?" returns the Master unit current multiplied by the number of Slave units.
3. UVL? will return "C01" if UVP is activated and vice versa.

7.8.6 Global Output Commands

General

Global commands can be received by all power supplies connected to the BUS, without individual address commands. All power supplies will execute the command immediately. There is no acknowledgment back to the PC when using global commands. A delay must be set of 20msec after each global command. Error messages are not reported back to the issuing PC.

GRST	Reset. Brings the Power Supply to a safe and known state: Output voltage: 0V, output current: 0A, OUT: Off, Remote: RMT 1' AST: Off OVP:Max, UVL:0. The conditional register (FLT and STAT) are updated. Other registers are not changed. Non-Latching faults (FoldBack, OVP, SO, UVP) are cleared, OUT fault stays.
GPV n	Sets the output voltage value in volts. The range of voltage values is shown in Table 7-3. 'n' may be up to 12 char plus dec. pt
GPC n	Program the output current value in amperes. The range of current values is shown in Table 7-4. 'n' may be up to 12 char plus dec. pt
GOUT	Turns the output to ON or OFF: "OUT 1/ON" = turn on "OUT 0/OFF"= turn off, clears CV and CC bits in the Status Condition (STAT). OUT ON will respond with "E07' if the output cannot be turned on because of a latching fault (OTP< AC, ENA, SO) shutdown.
GSAV	Save present settings. Same settings as power-down last settings listed in Error! Reference source not found. Except the address and Baud rate are not saved. Saves to the RAM. These settings are erased when the supply power is switched off and the new 'last settings' are saved.
GRCL	Recall last settings. Settings are from last power-down or from last 'SAV' or 'GSAV'. GRCL command. Address and Baud rate are not recalled so communication is not interrupted.

Model Rated Output Voltage (V)	Minimum (V)	Maximum (V)
10	00.00	10.00
20	00.00	20.00
36	00.00	36.00
60	00.00	60.00
100	000.0	100.0

Table 7-5: Voltage programming range

NOTE:

The power supply can accept values higher by 5% than the table values, however it is not recommended to program the power supply over the rated values.

Model	Minimum (A)	Maximum (A)
10-20	00.00	20.00
20-10	00.00	10.00
36-6	0.000	6.000
60-3.5	0.000	3.500
100-2	0.000	2.000

Table 7-6: Z200 models Current programming range

Model	Minimum (A)	Maximum (A)
10-40	00.00	40.00
20-20	00.00	20.00
36-12	00.00	12.00
60-7	0.000	7.000
100-4	0.000	4.000

Table 7-7: Z400 models Current programming range

NOTE:

The power supply can accept values higher by 5% than the table values, however it is not recommended to program the power supply over the rated values.

Model Rated Output Voltage (V)	Minimum (V)	Maximum (V)
10	0.5	12.0
20	1.0	24.0
36	2.0	40.0
60	5.0	66.0
100	5.0	110

Table 7-8: OVP programming range

Model Rated Output Voltage (V)	Minimum (V)	Maximum (V)
10	0	9.5
20	0	19.0
36	0	34.2
60	0	57.0
100	0	95.0

Table 7-9: UVL/UVP programming range

NOTE:

The UVP protection starts operating for values higher than 5% of Rated Output Voltage.

7.8.7 Auxiliary Commands

SOP	Sets SO polarity "SO 1/ON" –Positive (default), "SO 0/OFF"-Negative
SOP?	Returns the SO polarity
RIE	Remote inhibit (Interlock) enable. "RIE 1/ON"-Enable, "RIE 0/OFF"-Disable"
RIE?	Returns the RIE polarity. "ON" –interlock enable, "OFF"-interlock disable.
FRST	Factory reset command. This command cover *RST command and additional settings. Sets factory default. This command breaks communication. Refer to Table 5-9.
MP?	Reads the actual output power. Returns 5 digit string.
REL1	Set auxiliary programmed pin state J3-1. "REL1 1/ON"- High, REL1 0/OFF"- Low
REL1?	Response auxiliary programmed pin state J3-1.
REL2	Set auxiliary programmed pin state J3-6, "REL2 1/ON"- High, REL2 0/OFF"- Low
REL2?	Response auxiliary programmed pin state J3-6

7.8.8 Status Commands

Refer to section 9.3.1, 9.3.2 for Register definitions.

#	Command	Description
1	STT?	Reads the complete power supply status. Returns ASCII characters representing the following data, separated by commas: MV<actual (measured) voltage> PC<programmed (set) current> PV<programmed (set) voltage> SR<status register, 4-digit hex> MC<actual (measured) current> FR<fault register, 4-digit hex> Example response: MV(45.201),PV(45),MC(4.3257),PC(10),SR(0030),FR(0000)
2	FLT?	Reads Fault Conditional Register. Return 4-digit hex.
3	FENA	Set Fault Enable Register using 4-digit hex.
4	FENA?	Reads Fault Enable Register. Returns 4-digit hex.
5	FEVE?	Reads Fault Event Register. Returns 4-digit hex. Clears bits of Fault Event Register.
6	STAT?	Reads Status Conditional Register. Returns 4-digit hex.
7	SENA	Sets Status Enable Register using 4-digit hex.
8	SENA?	Reads Status Enable Register. Returns 4-digit hex.
9	SEVE?	Reads Status Event register. Returns 4-digit hex. Clears bits of Status Event register.

7.9 Serial Communication Test Set-Up

Basic set-up to test serial communication operation.

1. Equipment: PC with Windows Hyper Terminal, private edition, software installed, Z+ power supply, RS232 cable.

2. PC set-up:

2.1 Open Hyper Terminal.....New Connection.
2.2 Enter a name
2.3 Connect to.....Direct to Com1 or Com 2
2.4 Configure port properties:

Bits per second 9600
Data bits 8
Parity .....None
Stop bits.....1
Flow control.....None

2.5 Open Properties in the program File.....Properties

2.6 Setting: ASCII Set Up
Select Echo characters locally, select send line ends with line feed.
On some PC systems, pressing the number keypad "Enter" will distort displayed messages. Use the alphabetic "Enter" instead.

3. Power supply set-up:

3.1 Connect the power supply to the PC using the RS232 cable.
3.2 Set via the front panel: Baud Rate: 9600, Address: 06, RS232, GEN Language

4. Communication test:

4.1 Model identification:
PC: write: ADR 06
Power supply response: "OK"

4.2 Command test:
PC write: OUT 1
Power supply response: "OK"
PC write: PV n
Power supply response: "OK"
PC write: PC n (for n values see Tables 7-3, 7-4 and 7-5)
Power supply response: "OK"

The power supply should turn on and the display will indicate the output voltage and the actual output current.

7.10 SCPI Protocol

7.10.1 Data Format

Serial data format is 8 bit, one start bit and one stop bit. No parity bit.

7.10.2 End of Message

End of message is the Carriage Return character (ASCII 13) and the Line Feed (ASCII 10) character.

7.10.3 End of Command

End of command is Carriage Return character (ASCII 13) and/or the Line Feed (ASCII 10) character.

7.10.4 Checksum

The user may optionally add a checksum to the end of the command. The checksum is "$" followed by two hex characters. If a command or a query has checksum, the response will also have one. There is no CR between the command string and the "$" sign.

7.10.5 SCPI Requirements

The power supply conforms to the following SCPI requirements:

1. SCPI common commands.
2. SCPI Command Tree.
3 Subsystem commands.
4. The ROOT level.
5. The power supply is powered On
6. A device clear (DCL) is sent to the power supply
7. The SCPI interface encounters a root specifier (:)
8. Questionable Status Register (QSR), Condition, Event, Enable
9. Operation Status Register (OSR), Condition, Event, Enable
10. Status Byte Register (SBR)
11. Standard Event Status Register (SESR)
12. Using the MIN and MAX Parameters.
13. Suffix and Multipliers.
14. Boolean data. 1 | 0 or ON | OFF

7.10.6 SCPI Command Hierarchy

SCPI is an ASCII-based command language designed for use in test and measurement equipment. The command structure is organized around common roots, or nodes, which are the building blocks of SCPI subsystems. An example of a common root is OUTPut, and some of the commands that reside in the OUTPut subsystem are:

```
OUTPut
        [:STATe]<bool>
        :PON
                [:STATe]<bool>
        :PROTection
                :CLEar
                :FOLDback
                        [:MODE]
```

A colon (:) is used to separate a command keyword from a lower-level keyword.

7.10.7 Header

Headers are instructions recognized by the power supply. Headers (which are sometimes known as "keywords") may be either in long or short form.

Long form	The header is completely spelled out, such as VOLTAGE, STATUS, and DELAY
Short form	The header has only the first three or four letters, such as VOLT, STAT, and DEL.

The SCPI interface is not sensitive to case. It will recognize any case mixture, such as TRIGGER, Trigger, TRIGger. Short form headers result in faster program execution.

7.10.8 Data Formats

Data Formats	Description
<NR1>	Digits with an implied decimal point assumed at the right of the least-significant digit. Examples: 256
<NR2>	Digits with an explicit decimal point. Example: .0253
<NR3>	Digits with an explicit decimal point and an exponent. Example: 2.73E+2
<Nrf>	Extended format that includes <NR1>, <NR2> and <NR3>. Examples: 273 273.1 2.73E2
<Nrf+>	Expanded decimal format that includes <Nrf> and MIN MAX. Examples: 273,273.1, 2.73E2, MAX. MIN and MAX are the minimum and maximum limit values that are implicit in the range specification for the parameter.
<Bool>	Boolean Data. Example: 0 | 1 or ON | OFF

7.10.9 Character Data

<CRD>	Character Response Data. Permits the return of character strings.

7.10.10 Commands Notes

- Expressions enclosed in square brackets, [ ], are optional and entered without the [or].
- Expressions enclosed in greater than/less than, < >, are programming values and entered without the < or >.
- The expression <SP> represents a one character ASCII Space.
- In all commands upper case characters can be interchanged with lower case characters.

7.11 SCPI Common Commands

Common commands begin with an * and consist of three letters (command) or three letters and a ? (query). Common commands are defined by the IEEE 488.2 standard to perform some common interface functions. The power supply responds to the 11 required common commands that control SCPI Command Reference, synchronization, and internal operations. The power supply also responds to five optional common commands controlling triggers, power-on conditions, and stored operating parameters.

***CLS**

Clear Status command. Clears the entire status structure.

NOTE:

Execution time for this command 150mS

Meaning and Type	Clear Status
Command Syntax	*CLS
Parameters	None
Query Syntax	None

***ESE**

Standard Event Status Enable command. Modifies the contents of the Event Status Enable Register.

Meaning and Type	Event Status Enable	Device Status
Command Syntax	*ESE <NRf>	
Parameters	0 to 255	
Power On Value	1	
Query Syntax	*ESE?	
Parameters	<NR1> 3digits	
Query Syntax	*ESR? *PSC *STB?	

Bit Position	7	6	5	4	3	2	1	0
Bit Name	PON	0	CME	EXE	DDE	QYE	0	OPC
Bit Weight	128	64	32	16	8	4	2	1

CME = Command error; DDE = Device-dependent error; EXE = Execution error; OPC = Operation, complete; PON Power-on; QYE = Query error

***ESR?**

Standard Event Status Register query. Returns the contents of the Event Status Register.

Meaning and Type	Event Status	Device Status
Query Syntax	*ESR?	
Parameters	None	
Returned Parameters	<NR1> (Register binary value) format 3 digits	

***IDN?**

Identification query. Returns an identification string in the following format: 'Manufacturer, Model, Serial number, Firmware level'.

Meaning and Type	Identification System Interface	
Query Syntax	*IDN?	
Returned Parameters	Field	Information
	TDK-Lambda	Manufacturer
	Z	Model
	<Vrating>-<Irating>	Model ratings
	25B1234	Serial number, typically 7 alpha-numeric characters
	3.0-C1	Revisions, <Main firmware>–<LAN/IEEE firmware>
Example	TDK-Lambda,Z20-30,25B1234, 1.0-C1	

***OPC**

Operation Complete command. Sets the Operation Complete bit in the Standard Event Status Register if all commands and queries are completed.

Meaning and Type	Operation Complete	Device Status
Command Syntax	*OPC	
Parameters	None	

***OPC?**

Operation Complete query. Returns ASCII '1' as soon as all commands and queries are completed.

Meaning and Type	Operation Complete	Device Status
Query Syntax	*OPC?	
Parameters	<NR1> ASCII 1 is placed in the Output Queue when the power supply has completed operations.	

***OPT?**

The options (OPT) query returns a comma-separated list of all of the instrument options currently installed on the signal generator.

Parameter	Option
0	NONE
1	IEEE
2	LAN
3	BOTH

Query Syntax *OPT?
Returned Parameters <CRD>

***PSC**

The Power-On Status Clear (PSC) command controls the automatic power-on clearing of the Service Request Enable Register, the Standard Event Status Enable Register, and device-specific event enable registers.

- ON(1) - This choice enables the power-on clearing of the listed registers.
- OFF(0) - This choice disables the clearing of the listed registers and they retain their status when a power-on condition occurs.

Meaning and Type	Power-on Status Clear Device Initialization
Command Syntax	*PSC <bool>
Parameters	0 | 1 | OFF | ON
Example	*PSC 0 *PSC 1
Query Syntax	*PSC?
Returned Parameters	<NR1> 0 | 1

***RCL n**

Restores the power supply to a state previously stored in memory by *SAV command. Refer to Table 5-9.

Meaning and Type	Recall	Device State
Command Syntax	*RCL <NR1>	
Parameters	1 to 4	
Query Commands	*RCL 3	
Query Syntax	None	

***RST**

This command resets the power supply to a defined state as shown in Table 5-9. *RST also forces an ABORt command.

Meaning and Type	Recall	Device State
Command Syntax	*RST	
Parameters	None	
Example	None	

***SAV n**

The SAV command saves all applied configuration setting. Refer to Table 5-9.

Command Syntax	*SAV <NRf>
Parameters	1 to 4
Query Syntax	None

***SRE**

Service Request Enable command. Modifies the contents of the Service Request Enable Register.

Meaning and Type	Service Request Enable Device Interface
Command Syntax	*SRE <NRf>
Parameters	0 to 255
Default Value	See *PSC
Example	*SRE 20
Query Syntax	*SRE?
Returned Parameters	<NR1> (Register binary value) 3digits

***STB?**

Status Byte query. Returns the contents of the Status Byte Register.

Meaning and Type	Status Byte Device Status
Query Syntax	*STB?
Returned Parameters	<NR1> (Register binary value)

Bit Position	7	6	5	4	3	2	1	0
Condition	OPER	MSS	ESB	MAV	QUES	0	0	0
		(RQS)						
Bit Weight	128	64	32	16	8	4	2	1
ESB = Event status byte summary; M = Message available								
MSS = Master status summary; OPER = Operation status summary;								
QUES = Questionable status summary; RQS = Request for service								

Table 7-10: Bit Configuration of Status Byte Register

***TRG**

The Trigger command starts the waveform when the trigger source is set to BUS.

Meaning and Type	**Trigger**	**Device Trigger**
Command Syntax	*TRG	
Parameters	None	
Query Syntax	None	

ABORt

Resets the trigger system and places the power supply in an IDLE state without waiting for the completion of the trigger cycle.

Command Syntax	ABORt
Parameters	None
Example	ABOR
Query Syntax	None

7.12 SCPI Subsystem Commands

Subsystem commands are specific to power supply functions. They can be a single command or a group of commands. Groups are comprised of commands that extend one or more levels below the root.
Commands followed by a question mark (?) take only the query form. Except as noted in the syntax descriptions, all other commands take both the command and query form.

7.12.1 Output Subsystem

OUTPut	
[:STATe] <bool>	Enable/Disable output
:PON	
[:STATe] <bool>	Set power-on state in Safe or Auto start
:PROTection	
:CLEar	Reset latched protection
:FOLDback	
[:MODE] <CRD>	Protection at transition CC<->CV modes
:DELay <NRf+>	Delay after programming/before protection
:ILC	
:MODE <CRD>	Set remote inhibit input (ENAble|DISable)
:TTLTrg	
:MODE <CRD>	Set or disable Function Strobe Mode
:RELay	
[:STATe] <bool>	Set optionally output relay status
:MODE?	Replay operation mode CV/CC/OFF

OUTPut

This command enables or disables the power supply output. When output is turned off, voltage display shows "OFF".

SCPI Command Syntax	OUTPut[:STATe] <bool>
GEN Command Syntax	OUT <bool>
Parameters	0|OFF 1|ON
*RST Value	OFF
Examples	OUTP 1 OUTP:STAT ON
Query Syntax	OUTPut[:STATe]?
Returned Parameters	0|1

OUTPut:PON[:STATe]

- AUTO - The power supply output will return to its previous value when the latching fault condition is removed or to the stored value after AC recycle.
- SAFE - The power supply output will remain Off after the fault condition is removed or after AC recycle.

SCPI Command Syntax	OUTPut:PON[:STATe] <bool>
GEN Command Syntax	AST <bool>
Parameters	0|OFF 1|ON
*RST Value	OFF
Examples	OUTPut:PON 1
Query Syntax	OUTPut:PON[:STATe]?
Returned Parameters	0|1

OUTPut:PROTection:CLEar

This command clears the latch that disables the output when an over voltage (OVP), under voltage (UVP), or foldback (FOLD) fault condition is detected. All conditions that generate a fault must be removed before the latch can be cleared. The output is then restored to the state before the fault condition occurred.

SCPI Command Syntax	OUTPut:PROTection:CLEar
GEN Command Syntax	None
Parameters	None
Examples	OUTP:PROT:CLE

OUTPut:PROTection:FOLDback

Foldback mode is used to disable the output when a transition is made between the operation modes. The power supply will turn off the output after a specified delay if the power supply makes transition into CV mode or into CC mode. This feature is particularly useful for protecting current or voltage sensitive loads.

SCPI Command Syntax	OUTPut:PROT:FOLDback[:MODE] <CRD>
GEN Command Syntax	FLD <CRD>
Parameters	OFF|0, CC|1, CV|2 .
*RST Value	OFF
Examples	OUTPut:PROT:FOLDback[:MODE] CC
Query Syntax	OUTPut:PROT:FOLDback[:MODE]?
Returned Parameters	<CRD>

OUTPut:PROTection:DELay

Sets the delay time between the programming of an output change that produces a CV or CC status condition. This command applies to UVP and Foldback functions.

SCPI Command Syntax	OUTPut:PROTection:DELay <NRf+>
GEN Command Syntax	FBD
Parameters	0.1 to 25.5|MIN|MAX (step 0.1s)
Unit	S (second)
*RST Value	0mS
Examples	OUTPut:PROTection:DELay 2E-1
Query Syntax	OUTPut:PROTection:DELay?
Returned Parameters	<NR3>

OUTPut:ILC:MODE

Selects the mode of operation of the Remote Inhibit protection. In OFF mode the power supply ignores J3-4 (ILC) status.

SCPI Command Syntax	OUTPut:ILC:MODE <CRD>
GEN Command Syntax	RIE
Parameters	0|OFF 1|ON
*RST Value	OFF
Examples	OUTPut:ILC:MODE ON
Query Syntax	OUTPut:ILC:MODE?
Returned Parameters	ON/OFF

OUTPut:TTLTrg:MODE

Sets the operation of the Trigger Out signal to either OFF, Function Strobe or Trigger mode.
Programming Mode NONE, FIX:

- In TRIG mode, trigger is generated when output status changes.
- In Function Strobe mode, an output pulse is generated automatically any time an output parameter such as output, voltage or current is programmed.

Programming modes LIST or WAVE:

- In TRIG mode, trigger is generated when LIST or WAVE is completed.
- In Function Strobe mode, an output pulse is generated automatically any time a step is competed.

The power supply Trigger Out signal is available at J3-3 connector on the rear panel.

SCPI Command Syntax	OUTPut:TTLTrg:MODE <CDR>
GEN Command Syntax	None
Parameters	TRIG| FSTR|OFF
*RST Value	OFF
Examples	OUTP:TTLT:MODE TRIG
Query Syntax	OUTP:TTLT:MODE?
Returned Parameters	<CRD>

OUTPut:RELay1(2):STATe

Sets pin J3-1 (1) and J3-6 (2) state. The ON parameter is according to low level.

SCPI Command Syntax	OUTPut:RELay1(2)[:STATe] <bool>
GEN Command Syntax	REL1(2) <bool>
Parameters	0|OFF 1|ON
*RST Value	1
Examples	OUTP:REL1(2) 1 OUTP:REL1(2) ON
Query Syntax	OUTPut:REL1(2)[:STATe]?
Returned Parameters	0|1

OUTPut:MODE?

Returns the power supply to operation mode. When the power supply is On (OUT 1) it will return to "CV" or "CC". When the power supply is OFF (OUT 0) it will return to "OFF".

SCPI Query Syntax	OUTPut:MODE?
GEN Query Syntax	MODE?
Returned Parameters	<CRD> CV|CC|OFF

7.12.2 Instrument Subsystem

The subsystem programs one or more power supplies. <NRf> from 1 to 31.

INSTrument	
:COUPle ALL|NONE	Couple for all Z^+ power supplies
:NSELect <NRf>	Select the power supply to program

INSTrument:COUPle

SCPI Command Syntax	INSTrument:COUPle <CRD>
GEN Command Syntax	None
Parameters	ALL|NONE

INSTrument:NSELect

SCPI Command Syntax	INSTrument:NSELect
GEN Command Syntax	ADR <NRf> single address
Examples	INSTrument:NSELect 6
Query Syntax	INSTrument:NSELect?

7.12.3 Voltage Subsystem

```
VOLTage
        [:LEVel]
                [:IMMediate]
                    [:AMPLitude] <NRf+>          Set output voltage
                :TRIGger <NRf+>                  Set voltage value for trigger pending
        :PROTection
                [:OVER] <NRf+>                   Set OVP value
                : LOW
                        :STATe <CRD>             Set UVP|UVL mode
                        :[LEVel] <NRF+>          Set UVP|UVL value
        :CLEar
:MODE <CRD>                                      Select arbitrary trigger control mode
```

VOLTage

Sets the output voltage value in Volts. The range of voltage values are described in Table 7-3. The maximum number of characters is 12.

SCPI Command Syntax	[SOURce]:VOLTage[:LEVel] [:IMMediate][:AMPLitude] <NRf+>
GEN Command Syntax	PV < NRf+> PV?
Default Suffix	V
*RST Value	0
Examples	:VOLT 500 MV VOLT:LEV 234.56789
Query Syntax	[SOURce]:VOLTage[:LEVel][:IMMediate][:AMPLitude]? VOLTage? MAX VOLTage? MIN
Returned Parameters	<NR3> VOLT? returns the present programmed voltage level. VOLT? MAX and VOLT? MIN return the maximum and minimum programmable current levels.

VOLT:MODE

This command selects FIX, LIST, WAVE subsystems control over the power supply output voltage.

SCPI Command Syntax	[SOURce]:VOLTage:MODE <CRD>
GEN Command Syntax	None
Parameters	NONE | FIXed | LIST | WAVE
*RST Value	NONE
Examples	VOLT:MODE LIST VOLT:MODE FIX
Query Syntax	[SOURce]:VOLTage:MODE?
Returned Parameters	NONE | FIX | LIST | WAVE

NOTE:

VOLT:MODE LIST and WAVE is an implied ABORT command. WAVE mode cannot be programmed simultaneously for both Voltage and Current. Only the last sent command can be accepted as WAVE. Previous mode reverts to NONE.

VOLTage:PROTection:LEVel

Sets the OVP level. The OVP setting range is given in Table 7-8. The number of characters after OVP is up to 12. The minimum setting level is approx. 105% of the set output voltage, or the value in Table 7-8, whichever is higher.

SCPI Command Syntax	[SOURce]:VOLTage:PROTection:LEVel <nn.nn|MAX>
GEN Command Syntax	OVP < NRf+>
Default Suffix	V
*RST Value	MAX
Examples	VOLT:PROT:LEV 2.5
Query Syntax	[SOURce]:VOLTage:PROT:LEV? VOLT:PROT:LEVel? MIN VOLT:PROT:LEVel? MAX
Returned Parameters	<NR3> VOLT:PROT:LEV? returns presently programmed OVP level. VOLT:PROT:LEV? MAX and VOLT:PROT:LEV? MIN return the maximum and minimum programmable OVP levels.

NOTE:

VOLT:PROT:LEV MIN set OVP level 5% above voltage set value

VOLTage:PROTection:LOW:STATe

Sets the under voltage protection (UVP) status of the power supply. If the UVP status selected, then the under voltage protection is enabled.

SCPI Command Syntax	[SOURce]:VOLTage:PROTection:LOW:STATe <CRD>
GEN Command Syntax	UVL < NRf+> , UVP < NRf+>
Parameters	UVL|UVP
*RST Value	UVL
Examples	VOLT:PROT:LOW:STAT UVP
Query Syntax	[SOURce]:VOLTage:PROTection:LOW :STATe?
Returned Parameters	UVP|UVL

VOLTage:PROTection:LOW

Sets the over voltage protection (UVP) level of the power supply.

SCPI Command Syntax	[SOURce]:VOLTage:PROTection:LOW <NRf+>
GEN Command Syntax	UVL < NRf+> , UVP < NRf+>
Default Suffix	V
*RST Value	0
Examples	VOLT:UNDer:PROT 2.5 VOLT:UNDer:PROT:LEV MAX
Query Syntax	[SOURce]:VOLTage:PROTection:LOW [:LEVel]? VOLT:PROT:LOW? MIN; VOLT:PROT:LOW? MAX
Returned Parameters	<NR3> VOLT:PROT:UNDer? returns presently programmed UVP level. VOLT:UNDer:PROT? MAX and VOLT:PROT:OVER? MIN return the maximum and minimum programmable UVP levels.

NOTE:

VOLT:PROT:LOW MAX set UVP level maximum 5% below voltage value

VOLT:TRIG

Programs the pending triggered voltage level of the power supply. The pending triggered voltage level is a stored value that is transferred to the output terminals when a trigger occurs.

SCPI Command Syntax	[SOURce]:VOLTage[:LEVel]:TRIGgered [:AMPLitude] <NRf+>
GEN Command Syntax	None
Default Suffix	V
Examples	VOLT:TRIG 1200 MV VOLT:LEV:TRIG 1.2
Query Syntax	[SOURce]:VOLTage[:LEVel]:TRIGgered [:AMPLitude]? :VOLTage:TRIGgered? MAX; :VOLTage:TRIGgered? MIN
Returned Parameters	<NR3> VOLT:TRIG? returns the presently programmed voltage level. If the TRIG level is not programmed, the IMM level is returned. VOLT:TRIG? MAX and VOLT:TRIG? MIN return the maximum and minimum programmable triggered voltage levels.

7.12.4 Current Subsystem

This subsystem programs the output current of the power supply.

```
CURRent
        [:LEVel]
            [:IMMediate]
                [:AMPLitude] <NRf+>     Set output Current
            :TRIGger <NRf+>             Set current value for trigger pending
        :MODE <CRD>                     Select arbitrary trigger control mode
```

CURRent

Sets the output current value in Amperes. The range of current values are described in Tables 7-4 and 7-5. The maximum number of characters is 12.

SCPI Command Syntax	[SOURce]:CURRent[:LEVel] [:IMMediate][:AMPLitude] <NRf+>
GEN Command Syntax	PC <NRf+> PC?
Default Suffix	A
*RST Value	0
Examples	CURR 500 MA CURR:LEV .5
Query Syntax	[SOURce]:CURRent[:LEVel][:IMMediate][:AMPLitude]? [SOURce]:CURRent? MAX [SOURce]:CURRent? MIN
Returned Parameters	<NR3> CURR? returns the present programmed current level. CURR? MAX and CURR? MIN return the maximum and minimum programmable current levels.

CURR:MODE

This command selects FIX, LIST, WAVE subsystems control over the power supply output current.

SCPI Command Syntax	[SOURce]:CURRent:MODE <CRD>
GEN Command Syntax	None
Parameters	NONE | FIXed | LIST | WAVE
*RST Value	NONE
Examples	CURR:MODE LIST CURR:MODE FIX
Query Syntax	[SOURce]:CURRent:MODE?
Returned Parameters	NONE | FIX | LIST | WAVE

CURRent:TRIGger

Programs the pending triggered current level of the power supply. The pending triggered current level is a stored value that is transferred to the output terminals when a trigger occurs.

SCPI Command Syntax	[SOURce]:CURRent[:LEVel]:TRIGgered[:AMPLitude] <NRf+>
GEN Command Syntax	None
Default Suffix	A
Examples	CURR:TRIG 3200 MA CURR:LEV:TRIG 3.2
Query Syntax	SOURce]:CURRent[LEVel]:TRIGgered [:AMPLitude]? [SOURce]:CURRent? MAX [SOURce]:CURRent? MIN
Returned Parameters	<NR3> CURR:TRIG? returns the presently programmed triggered level. If no triggered level is programmed, the CURR level is returned. CURR:TRIG? MAX and CURR:TRIG? MIN return the maximum and minimum programmable triggered current levels.

NOTE:

CURR:MODE LIST and WAVE are an implied ABORt command. Only the last sent command can be accepted as WAVE or LIST. Previous mode reverts to NONE.

7.12.5 Measure Subsystem

This subsystem reads the actual voltage and current. The power is a result of multiplying voltage and current measurements.

MEASure

:CURRent[:DC]?

:VOLTage[:DC]?

:POWer[:DC]?

MEASure:CURR?

Reads the measured output current. Returns a 5 digit string.

SCPI Command Syntax	MEASure:CURRent?
GEN Command Syntax	MC?
Parameters	None
Default Suffix	A
Returned Parameters	<NR3>

MEASure:VOLTage?

Reads the measured output voltage. Returns a 5 digit string.

SCPI Command Syntax	MEASure:VOLTage?
GEN Command Syntax	MV?
Parameters	None
Default Suffix	V
Returned Parameters	<NR3>

MEASure:POWer?

Reads the measured output power. Returns a 5 digit string.

SCPI Command Syntax	MEASure:POWer?
GEN Command Syntax	MP?
Parameters	None
Default Suffix	W
Returned Parameters	<NR3>

7.12.6 DISPlay Subsystem

DISPlay

[:WINDow]:STATus <bool> Display ON/FF

[:WINDow]:FLASh <bool> Display Flash

DISPlay:STATus

Turns front panel voltage and current display toggle On or Off.

SCPI Command Syntax	DISPlay[:WINDow]:STAT <bool>
GEN Command Syntax	none
Parameters	0|OFF 1|ON
Examples	DISP:STAT 1 DISP:STAT OFF
Query Syntax	DISPlay[:WINDow]:STAT?
Returned Parameters	0 |1

DISPlay:FLASh

Makes front panel voltage and current displays flash.

SCPI Command Syntax	DISPlay[:WINDow]:FLASh <bool>
GEN Command Syntax	none
Parameters	0|OFF 1|ON
Examples	DISP:FLASh 1 DISP:FLASh OFF
Query Syntax	DISP:FLASh?
Returned Parameters	0 |1

7.12.7 INITiate Subsystem

INITate

[:IMMediate]

:CONTinuous <bool>

INITiate

Enables the trigger subsystem. If a trigger circuit is not enabled, all trigger commands are ignored.

SCPI Command Syntax	INITiate[:IMMediate]
GEN Command Syntax	None
Parameters	None
Examples	INIT:IMM
Query Syntax	None

INITiate:CONTinuous

- INIT:CONT 0 - Enables the trigger subsystem only for a single trigger action. The subsystem must be enabled prior to each subsequent trigger action.
- INIT:CONT 1 - Trigger system is continuously enabled and INIT is redundant.

SCPI Command Syntax	INITiate:CONTinuous <bool>
Parameters	0|OFF 1|ON
Examples	INIT:CONT 1 INIT:CONT ON
Query Syntax	INITiate:CONTinuous?
Returned Parameters	0 |1

NOTE:

When power supply is in INIT:CONT ON mode, it's impossible to change any programming parameter. Display shows "Err". Send ABORt commands to allow parameter change.

7.12.8 LIST Subsystem

[SOURce]
:LIST
:COUN <NRf>
:CURR <NRf>
:LOAD <NR1>
:STEP
:STORe <NR1>
:DWELl <NRf>
:VOLT <NRf+>

This subsystem receives parameters to create a step waveform of the output voltage or current.

NOTE:

All list subsystem commands (as well as CURR:MODE LIST and VOLT:MODE LIST) are implied ABORt commands.

LIST:COUN

Sets the number of times that the list is executed before it is completed. The command accepts parameters in the range 1 through 9999, but any number greater than 9999 is interpreted as INFinity. Use INF if you wish to execute a list indefinitely.

SCPI Command Syntax	[SOURce]:LIST:COUNt <NRf>
Parameters	1 to 9999 | INFinity
*RST	1
Examples	LIST:COUN 3 LIST:COUN INF
Query Syntax	[SOURce]:LIST:COUNt? (if count>9999 the response is INF)
Returned Parameters	<NR3>

LIST:CURR

Specifies the output current points in a list. The current points are given in the command parameters, which are separated by commas.

SCPI Command Syntax	[SOURce]:LIST:CURRent <NRf+> {,<NRf+>}
Default Suffix	A
Examples	LIST:CURR 2.5,3.0,3.5 LIST:CURR MAX,2.5,MIN up to 12 parameters
Query Syntax	LIST:CURRent
Returned Parameters	2.5,3.0,3.5

LIST:LOAD

Loads from memory LIST type. Type voltage/current values, dwell values, STEP parameter and counter specified in stored numbers <1..4>

SCPI Command Syntax	[SOURce]LIST:LOAD <NR1>
Examples	LIST:LOAD 3
Query Syntax	none
Returned Parameters	1..4

LIST:DWEL

Specifies the time interval that each value (point) of a list is to remain in effect.

SCPI Command Syntax	[SOURce]:LIST:DWEL <NRf+> {,<NRf+>}
Range	0.01 to 65 |MINimum | MAXimum
Default Suffix	S
Examples	LIST:DWEL .6,1.5,1.5,.4 up to 12 parameters
Related Commands	CURR:MODE LIST:COUN LIST:CURR LIST:STEP LIST:VOLT VOLT:MODE
Query Syntax	LIST:DWEL?
Returned Parameters	.6,1.5,1.5,.4

LIST:STEP

Determines if a trigger causes a list to advance only to its next point or to sequence through all the points.

- LIST:STEP AUTO - When triggered, it creates waveforms consecutively, until the list is completed.
- LIST:STEP ONCE - When triggered, it executes one step from the list.

SCPI Command Syntax	[SOURce]:LIST:STEP <CRD>
Parameters	AUTO | ONCE
*RST	AUTO
Examples	LIST:STEP ONCE
Query Syntax	[SOURce]:LIST:STEP?
Returned Parameters	AUTO | ONCE

LIST:VOLT

Specifies the output voltage points in a list. The voltage points are given in the command parameters, which are separated by commas.

SCPI Command Syntax	[SOURce]:LIST:VOLTage <NRf+> {,<NRf+>}
Default Suffix	V
Examples	LIST:VOLT 2.0,2.5,3.0 LIST:VOLT MAX,2.5,MIN up to 12 parameters
Query Syntax	LIST:VOLT?
Returned Parameters	2.0,2.5,3.0

LIST:STORe

Saves data under specified numbers <1..4> of the last LIST typed (voltage or/and current, dwell time, STEP parameter and counter).

SCPI Command Syntax	[SOURce]LIST:STORe <NF1>
Examples	LIST:STORe 3

7.12.9 STATus Subsystem

Refer to Fig. 9-1 for more details.

STATus		
	:OPERation	Returns the value of the Event register
	[:EVENt]	Returns the value of the Condition register
	:CONDition	Set current value for Trigger pending
	:ENABle <NR1>	Enables specific bits in the Event register
	:QUEStionable	
	[:EVENt]	Returns the value of the Event register
	:CONDition	Returns the value of the Condition register
	:ENABle <NR1>	Enables specific bits in the Event register

STATus:OPERation:EVENt?

This query returns the value of the Event register. This is a read-only register that receives data from the Condition register according to Enable register setting. Reading the Event register clears it.

SCPI Command Syntax	STATus:OPERation:EVENt?
GEN Command Syntax	SEVE?
Parameters	None
Returned Parameters	<NR1> (Register Value) decimal
Examples	STAT:OPER:EVEN?

STATus:OPERational:CONDition?

Returns the value of the Condition register, which is a read-only register that holds the real-time (unlatched) operational status of the power supply.

SCPI Command Syntax	STATus:OPERation:CONDition?
GEN Command Syntax	STAT?
Parameters	None
Returned Parameters	<NR1> (Register Value) decimal
Examples	STAT:OPER:COND?

STATus:OPERational:ENABle

Sets the value of the Enable register. This register is a mask for enabling specific bits from the Condition register to the Event register.

SCPI Command Syntax	STATus:OPERation:ENABle <NRf>
GEN Command Syntax	SENA nnnn, SENA?
Parameters	0…7FFF
Returned Parameters	<NR1> (Register Value) decimal
Default Value	0
Query Syntax	STATus:OPERation:ENABle?
Examples	STAT:OPER:ENAB 1312 STAT:OPER:ENAB 1

STATus:QUEStionable:EVENt?

This query returns the value of the Event register. It is a read-only register that receives data from the Condition register according to Enable register setting. Reading the Event register clears it.

SCPI Command Syntax	STATus:QUEStionable:EVENt?
GEN Command Syntax	FLT?
Parameters	None
Returned Parameters	<NR1> (Register Value) decimal
Examples	STAT:QUES:EVEN?

STATus:QUEStionable:CONDition?

Returns the value of the Condition register, which is a read-only register that holds the real-time (unlatched) operational status of the power supply.

SCPI Command Syntax	STATus:QUEStionable:CONDition?
GEN Command Syntax	FEVE?
Parameters	None
Returned Parameters	<NR1> (Register Value) decimal
Examples	STAT: QUES: COND?

STATus:QUEStionable:ENABle

Sets the value of the Enable register. This register is a mask for enabling specific bits from the Condition register to the Event register.

SCPI Command Syntax	STATus:QUEStionable:ENABle <NRf>
GEN Command Syntax	FENA nnnn
Parameters	0 to 32727
Returned Parameters	<NR1> (Register Value) decimal
Default Value	0
Query Syntax	STATus: QUEStionabl:ENABle?
Examples	STAT:QUES:ENAB 18

7.12.10 SYSTem Subsystem

SYSTem	
:ERRor:ENABle	Enable Error Message
:ERRor?	Read system error Error Messages
:LANGuage	
:REMote	
[:STATe]	Set program mode "0|LOC"- Local, "1|REM" – Remote, "2|LLO"- Go to Lockout
:VERSion	Software revision
:DATE	Calibration Date
:PON:TIME?	Response time from last reset

SYSTem:ERRor:ENABle

Enables Error messages.

SCPI Command Syntax	SYSTem:ERRor:ENABle
GEN Command Syntax	None
Parameters	None
Returned Parameters	None

SYSTem:ERRor?

Returns the next error number and corresponding error message in the power supply error queue. Works as FIFO. When no error exists 0, "No error" is returned.

SCPI Command Syntax	SYSTem:ERRor?
GEN Command Syntax	None
Parameters	None
Returned Parameters	<NR1>,<SRD>
Example	SYST:ERR?

SYSTem:LANGuage

SCPI Command Syntax	SYSTem:LANGuage GEN
GEN Command Syntax	LANG SCPI
Parameters	GEN
Returned Parameters	<CRD>
Example	SYST:LANG?

SYSTem:REMote

Sets the power supply to local or remote mode.

SCPI Command Syntax	SYSTem:REMote[:STAte] <CRD>
GEN Command Syntax	REM
Parameters	LOC/0|RMT/1|LLO/2
*RST Value	LOC
Examples	SYST:REM RMT
Query Syntax	SYST:REM?
Returned Parameters	LOC|RMT|LLO

SYSTem:VERSion?

SCPI Command Syntax	SYSTem:VERSion? <CRD>
GEN Command Syntax	REV?
Parameters	Rev:1.0.1.0

SYSTem:DATE?

SCPI Command Syntax	SYSTem:DATE <CRD>
GEN Command Syntax	DATE?
Parameters	2009.11.01
Query Syntax	SYSTem:DATE?
Returned Parameters	2009.11.01

SYSTem:PON:TIME?

Time measured from first power On.

SCPI Command Syntax	SYSTem:PON:TIME?
Parameters	Minute
Examples	6534
Returned Parameters	<NRf>

7.12.11 TRIGger Subsystem

TRIGger		
[:START]		Run trigger
	DELay <NRf+>	Set trigger delay
	:SOURce <CRD>	Set trigger source

NOTE:

The Trigger subsystem must be enabled from the Initiate subsystem or no triggering action will occur.

TRIGger

When the Trigger subsystem is enabled, TRIG generates an immediate trigger signal that bypasses selected TRIG:DEL.

SCPI Command Syntax	TRIGger[:STARt][:IMMediate]
GEN Command Syntax	None
Parameters	None
Returned Parameters	TRIG TRIG:IMM
Query Syntax	None

TRIGgger:DELay

Sets the time delay between the detection of an event on the specified trigger source and the start of any corresponding trigger action on the power supply output.

SCPI Command Syntax	TRIGger[:STARt]:DELay <NRf+>
GEN Command Syntax	None
Default Suffix	S
*RST Value	0
Examples	TRIG:DEL .25 TRIG:DEL MAX
Query Syntax	TRIGger[:STARt]:DELay?
Returned Parameters	<NR3> 0…65.000s

TRIGger:SOURce

Selects the power supply input trigger source as follows:

- BUS (*TRG & TRIG) and Front Panel
- EXT Mainframe backplane Trigger IN PIN

SCPI Command Syntax	TRIGger[:STARt]:SOURce <CRD>
GEN Command Syntax	None
Parameters	BUS | EXT
*RST Value	EXT
Examples	TRIG: SOUR BUS
Query Syntax	TRIGger[:STARt]:SOURce?
Returned Parameters	BUS | EXT

7.12.12 WAVE Subsystem

[SOURce]
:WAVE
:COUN <NRf>
:CURR <NRf>
:LOAD <NR1>
:STEP
:STORe <NR1>
:TIME <NRf>
:VOLT <NRf+>

This subsystem receives parameters to create a sloped waveform of the output voltage or current.

WAVE:COUN

Sets the number of times that the list is executed before it is completed. The command accepts parameters in the range 1 through 9999. Any number greater than 9999 is interpreted as INFinity. Use INF if you wish to execute a list indefinitely.

SCPI Command Syntax	[SOURce]:WAVE:COUNt <NRf+>
Parameters	1 to 9999 | INFinity
*RST	1
Examples	WAVE:COUN 3 WAVE:COUN INF
Query Syntax	[SOURce]:WAVE:COUNt? (if count>9999 the response is INF)
Returned Parameters	<NR3>

WAVE:CURR

This command specifies the output current points in a waveform list. The current points are given in the command parameters, which are separated by commas.

SCPI Command Syntax	[SOURce]:WAVE:CURRent <NRf+> {,<NRf+>}
Default Suffix	A
Examples	WAVE:CURR 2.5,3.0,3.5 up to 12 parameters
Query Syntax	WAVE:CURR?
Returned Parameters	<NR3>

WAVE:LOAD

Loads Voltage or Current, Time, STEP parameter and counter values to a specific location in the memory defined by numbers <1..4>.

SCPI Command Syntax	[SOURce]WAVE:LOAD <NR1>
Examples	WAVE:LOAD 3
Query Syntax	none
Returned Parameters	1..4

WAVE:STEP

- WAVE:STEP AUTO - When triggered, creates waveforms consecutively, until the count is completed.
- WAVE: STEP ONCE - When triggered, creates a waveform one time only.

SCPI Command Syntax	[SOURce]WAVE:STEP AUTO|ONCE
Examples	WAVE:STEP AUTO
Query Syntax	[SOURce]:WAVE:STEP?
Returned Parameters	AUTO | ONCE

WAVE:STORe

Stores Voltage or Current, Time, STEP parameter and counter values to specific location in the memory defined by numbers <1..4>.

SCPI Command Syntax	[SOURce]WAVE:STORe<NF1>
Examples	WAVE:STORe 3

WAVE:TIME

Sets the slope time of the waveform.

SCPI Command Syntax	[SOURce]:WAVE:TIME <NRf1> {,<NRf1>}
Range	0.01 to 65 |MINimum | MAXimum
Default Suffix	S
Examples	WAVE:TIME .6,1.5,1.5,.4 up to 12 parameters
Query Syntax	WAVE:TIME?
Returned Parameters	.6,1.5,1.5,.4

WAVE:VOLT

Specifies the output voltage points in a waveform list.

SCPI Command Syntax	[SOURce]:WAVE:VOLTage <NRf+> {,<NRf+>}
Default Suffix	V
Examples	WAVE:VOLT 2.5,3.0,3.5 WAVE:VOLT MAX,2.5,MIN up to 12 parameters
Query Syntax	WAVE:VOLT?
Returned Parameters	MAX,2.5,MIN

7.12.13 Global Subsystem

Global Commands General

- Power supplies acting upon Global Commands need not be a currently addressed supply.
- All power supplies attached to the Interface must be capable of accepting Global Commands.
- No messages, OPC or Not Busy will be returned to the HOST PC after a Global Command has been issued. The Busy Bit of the Status Byte will be set to 0 after this command is issued.
- It will be the responsibility of the User Software to add a 20mS delay after each Global Command is issued and before any other command can be issued.

Global Commands List

Command Name	Description	SCPI Format	GEN Format	Result From Supply
Enable all Outputs	Output On to last V & I levels	GLOBal:OUTPut:STATe 1|ON	GOUT 1	None
Disable all Outputs	Turn outputs Off to zero V & I	GLOBal:OUTPut:STATe 0|OFF	GOUT 0	None
Program all Voltages	Set all power supply output voltage	GLOBal:VOLTage:[AMPLitude] xxx.yy	GPV xxx.yy	None
Program all Currents	Set all power supply output current	GLOBal:CURRent:[AMPLitude] xxx.yy	GPC xxx.yy	None
Save Settings of all power supplies	Same as *SAV n	GLOBal:*SAV <NRf>	GSAV n	None
Recall Settings of all power supplies	Same as *RCL n	GLOBal:*RCL <NRf>	GRCL n	None
Reset all supplies	Same as *RST	GLOBal:*RST	GRST	None

Table 7-11: Global Commands

8.1 Introduction

This chapter describes the advanced functions of output programmable modes. The are three programmable modes: FIX, WAVE and LIST. The user can program the output transient state. The programmable modes are synchronized by input trigger (refer to section 8.5.1). According to the selected mode, the power supply activates the output trigger on J3-3 (refer to section 8.5.2).

8.2 FIX Mode

Output value is changed via input trigger. Refer to 7.12.3 VOLT:TRIG and 7.12.4 CURRent:TRIGger.

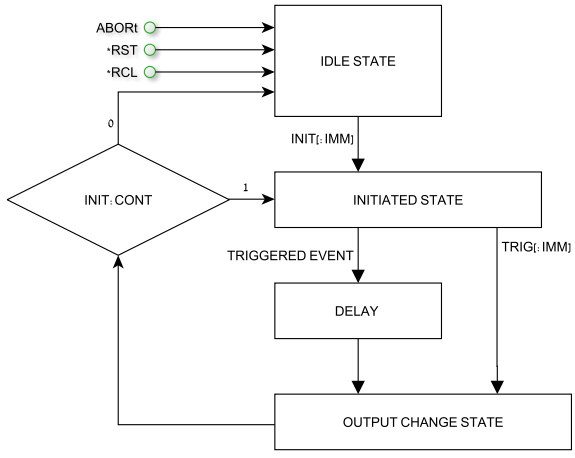


Fig.8-1: Simplified Models of FIX Mode

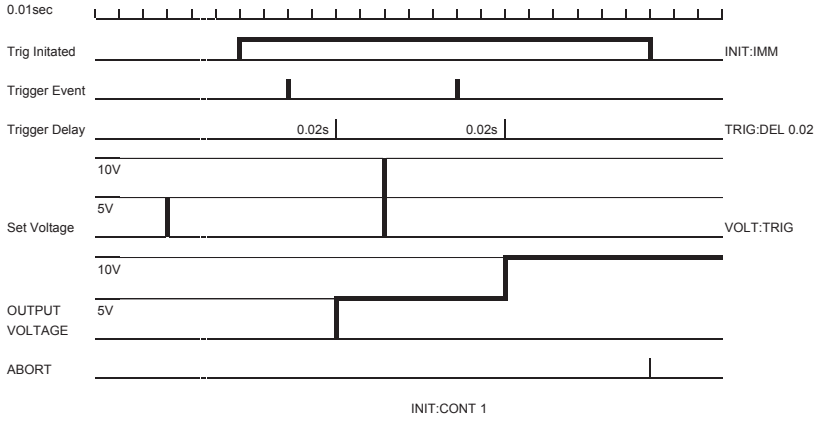


Fig.8-2: Fix Mode Sequence example

8.3 LIST Mode

Output change value in step determined by parameters in the LIST subsystem via input trigger. Refer to section 7.12.8

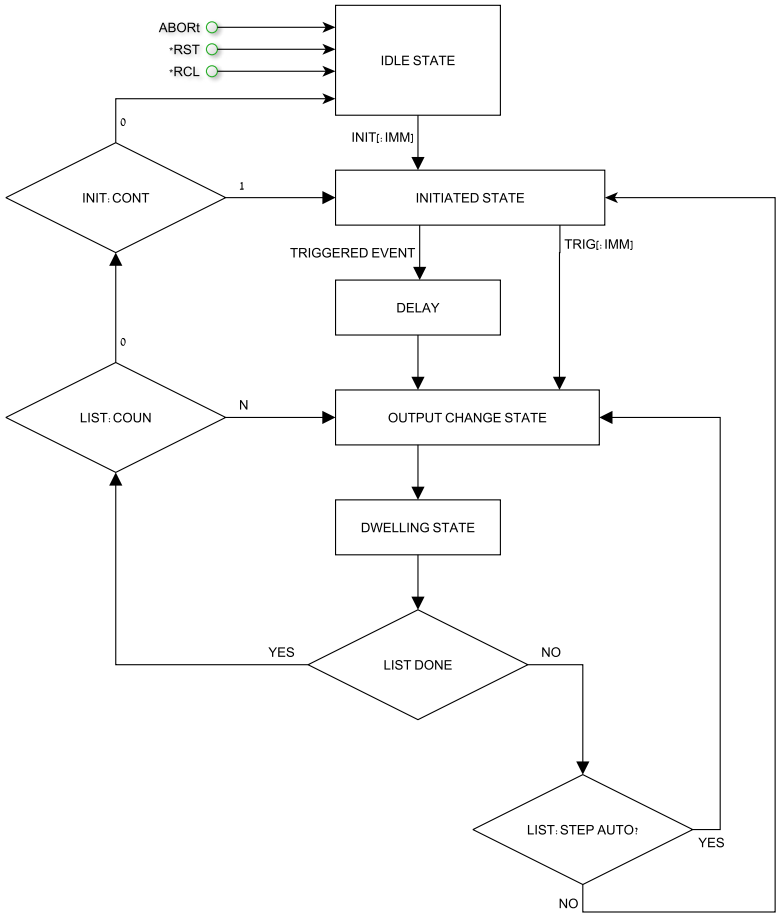


Fig.8-3: Simplified Models of LIST Mode

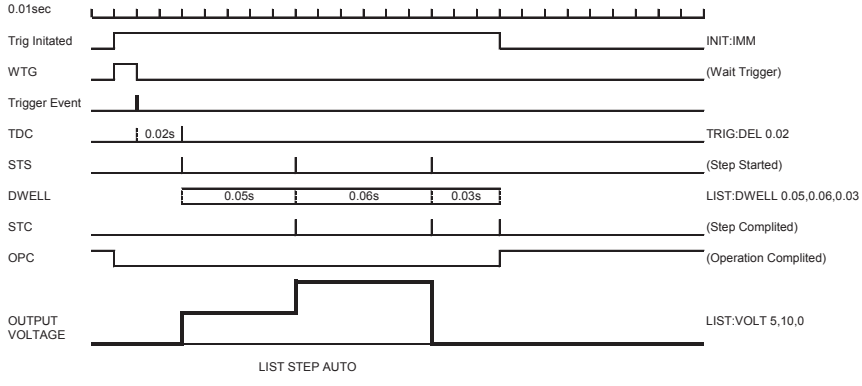


Fig.8-4: LIST Mode Sequence example

8.4 WAVE Mode

Output change value in slope determined by parameters in the WAVE subsystem via input trigger. Refer to section 7.12.12.

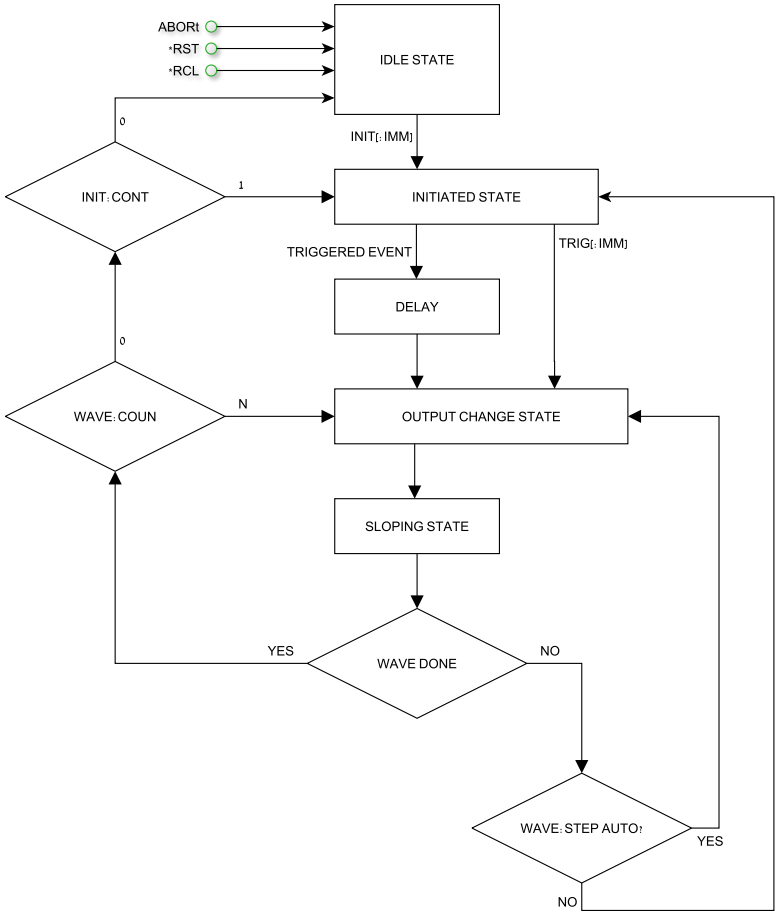


Fig.8-5: Simplified Models of Trigger in WAVE Mode

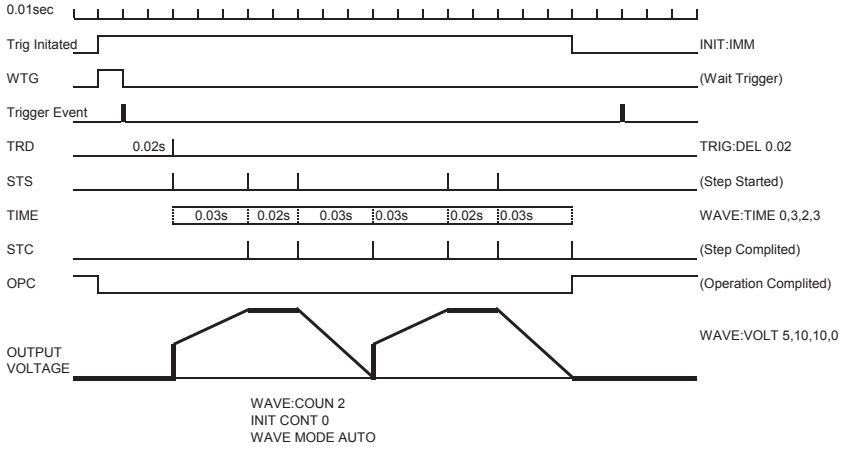


Fig.8-6: WAVE Mode Sequence example

8.5 Trigger

8.5.1 Input Trigger

Trigger source can be set via:

- BUS - Command (Refer to section 7.11 *TRG, 7.12 TRIGger) or Front Panel.
- EXT - Rear panel connector J3-8 (Refer to section 4.3.2).

Input Trigger source setting via Front Panel:

1. Press MENU button. MENU (green) LED illuminates. "SEt" message appears on the Voltage display.
2. Rotate Voltage Encoder until "trig" message appears.
3. Press Voltage Encoder. "init" message appears on Current Display.
4. Rotate Voltage Encoder until "tr.in" message appears. Press Voltage Encoder.
5. "tr.in" message appears on Voltage Display and "EHt" or "bUS" messages appear on Current Display. Rotate to scroll list and press current Encoder to select.

8.5.2 Output Trigger

Rear panel connector J3-3 (Refer to section 4.3.2). There are three output trigger modes:
Programming Mode NONE, FIX:

- OFF – No Trigger out.
- In TRIG mode, trigger is generated when output status changes.
- In Function Strobe mode, an output pulse is generated automatically any time an output parameter such as output, voltage or current is programmed.

Programming modes LIST or WAVE:

- OFF – No Trigger out.
- In TRIG mode, trigger is generated when LIST or WAVE is completed.
- In Function Strobe mode, an output pulse is generated automatically any time a step is competed.

Output Trigger mode settings:

1. Press MENU button. MENU (green) LED illuminates. "SEt" message appears on the Voltage display.
2. Rotate Voltage Encoder until "trig" message appears.
3. Press Voltage Encoder. "init" message appears on Current Display.
4. Rotate Voltage Encoder until "tr.ou" message appears. Press Voltage Encoder.
5. "tr.ou" message appears on Voltage Display and "OFF" , "trig", "F.Str" messages appear on Current Display. Rotate to scroll list and press current Encoder to select.

8.6 Transient Waveform Example

8.6.1 Wave Programing

1. Select required transient operation mode Insert communication command (Example: VOLT:MODE WAVE).
2. Set Voltage values Insert communication command (Example: WAVE:VOLT 5,10,10,0).
3. Set Timing values Insert communication command (Example: WAVE:TIME 0,2,3,2).
4. Set Counter value for sequence execution (Example: WAVE:COUN 2).
5. Set Step parameter AUTO or ONCE (Example: WAVE:STEP AUTO).
6. In this step possible store program in memory and continue programming without PC connection Insert communication command (Example: WAVE:STORe 2).
7. Recycle AC power. Set OUT ON.

8.6.2 Wave Execution via Communication PC

1. Load stored data Insert communication command (Example: WAVE:LOAD 2)
2. Set COUNTER (How many times program will be repeated if STEP in AUTO mode). Insert communication command (Example: WAVE:COUN 2)
3. Set Trigger IN source (BUS for Command or Front Panel and EXT via Rear Panel J3-8 pin) Insert communication command (Example: TRIG:SOUR BUS)
4. Set Trigger Initialize Continue mode (If 1 then after program execution power supply will be ready for next trigger. If 0 then send INIT command to get to the next trigger. Insert communication command (Example: INIT:CONT 1)
5. Send INIT command. (Power supply ready for TRIGGER). Insert communication command (Example: INIT).
6. Send *TRG command or press Current Encoder.

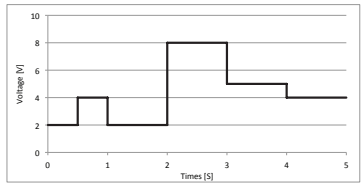
8.6.3 Wave Execution via Front Panel

1. Load stored data MENU -> "PrOG" -> "LOAd" -> L2
2. Set Trigger IN source (BUS for Command or Front Panel and EXT via Rear Panel J3.2 pin) MENU -> "trIG" -> "tr. in" -> "bUS"
3. Set Trigger Initialize Continue mode (If 1 then after program execution power supply will be ready for the next trigger. If 0 then send INIT command MENU -> "trIG" -> "CONt" -> "EnA" to get to the next trigger.
4. Set INIT command. (Power supply ready for TRIGGER) MENU -> "trIG" -> "InIt" -> "InIt"
5. Exit from MENU and Press Current Encoder to trigger.

8.7 Additional Examples

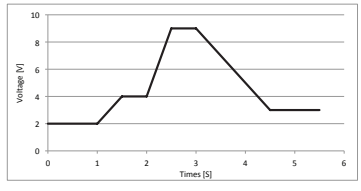
8.7.1 List Example

TRIG:SOUR BUS	Select trigger source external analog signal
VOLT:MODE LIST	Select sequence mode "LIST"
LIST:VOLT 2,4,2,8,5,4	Set voltage values "2,4,2,8,5,4" Volts
LIST:DWEL 0.5,0.5,1,1,1,1	Set dwell values "0.5,0.5,1,1,1,1" seconds
LIST:COUN 1	Set list execution time "1"
LIST:STEP AUTO	Set step execution mode "AUTO"
INIT:CONT OFF	Trigger subsystem enabled for a single trigger action
INIT	Trigger initializing
*TRG	Trigger command



8.7.2 Waveform Example

TRIG:SOUR BUS	Select trigger source via communication interface or front panel
VOLT:MODE WAVE	Select sequence mode "WAVE"
WAVE:VOLT 2,2,4,4,9,9,3,3	Set voltage values "2,2,4,4,9,9,3,3" Volts
WAVE:TIME 0,1,0.5,1,0.5,0.5,1.5,1	Set time values "0,1,0.5,1,0.5,0.5,1.5,1" seconds
WAVE:COUN 2	Set wave execution time "2"
WAVE:STEP AUTO	Set step execution mode "AUTO"
INIT:CONT ON	Trigger system is continuously enabled
INIT	Trigger initializing
*TRG	Trigger command



Subsystem Level	Display	Function Level	Display	Parameter Level	Display	Description
Trigger Setting	trig	INIT	init	INIT	init	Initialization (Refer to command INIT) ready for trigger.
				TRIG	trig	
		Continue	Cont	ENA	EnA	refer to command INIT:CONT
				DIS	dis	
		Trigger IN (input trigger)	tr.in	BUS (via Software or front Panel),	bUS	refer to command TRIG:SOUR
				EXT (Analog)	EHt	
		Trigger delay	tr.dL	0-65.44sec	0.100	refer to command TRIG:DELAY. Fine and Course modes
		Trigger OUT	tr.Ou	OFF	OFF	refer to command OUTP:TTLT:MODE
				Trigger	trig	
				Function Strobe	FStr	
Programming	PrOG	LOAD List or Wave data	LOAd	L1…L4	L2	Refer to commands LIST:LOAD and WAVE:LOAD
		COUNter (set repeat time)	COUn	1…9999	12	(Refer to LIST:COUN and WAVE:COUN) allow course and fine setting
		STEP setting	StEP	ONCE	OnCE	(Refer to LIST:STEP and WAVE:STEP)
				AUTO	AUtO	
		ABORt execution	Abor	YES	YES	(Refer to command ABORt)

Table 8-1: Trigger and Programming front panel menu

NOTE:

At AC power ON the display shows last selected program list but dosen't load it from memory.

NOTE:

If during program selection L1-L4, display shows "Err" message then program memory is empty or power supply is in initiated state. Select "ABORt" to EXIT from initiate state.

CHAPTER 9: STATUS, FAULT AND SRQ REGISTERS

9.1 General

This section describes various status errors (faults) and SRQ register structures. The registers can be read or set via the RS232/485/USB commands. Refer to Fig.9-1 for the Status and Fault Registers Diagram.

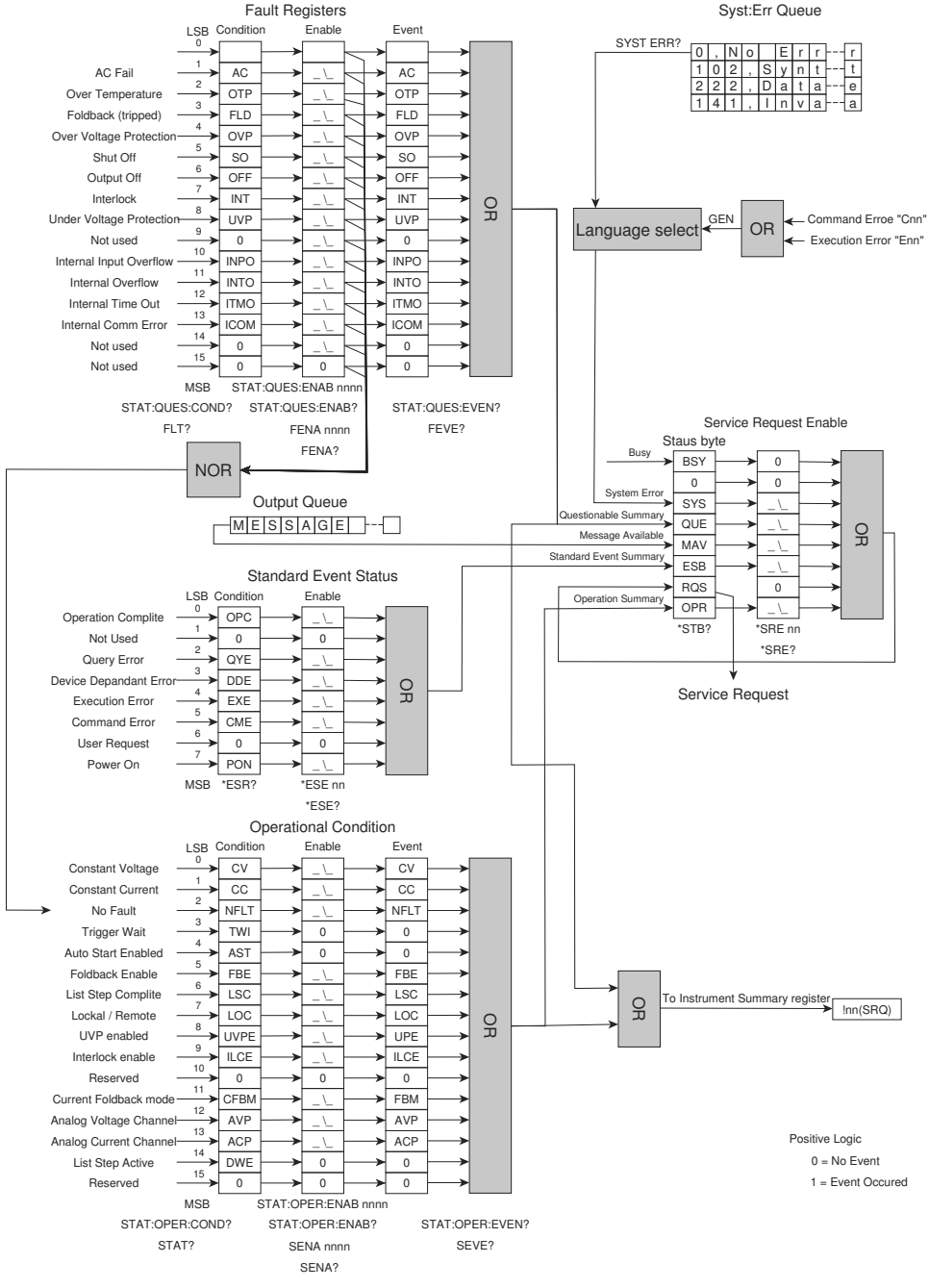


Fig.9-1: Status and Fault Registers Diagrams (SCPI)

9.2 Power Supply Status Structure

Status and Fault Register shows the status register structure of the power supply. The Standard Event, Status Byte, and Service Request Enable registers and the Output Queue perform standard functions as defined in the IEEE 488.2 Standard Digital Interface for Programmable Instrumentation. The Operation Status and Questionable Status registers implement status functions specific to the power supply.

9.3 Condition Registers

There are two registers that the user may read to see the condition of the supply. The register bits are set to show a fault or if an operating mode is active. The bits are cleared when the fault or mode is cleared. The registers are read-only.

9.3.1 Fault Register

The fault register sets a bit when a Fault occurs (Refer to table 9-1). The bit is cleared when the fault condition is removed.

Bit Number	Decimal Value	Bit Symbol	Description
0	1		
1	2	AC	AC Fail
2	4	OTP	Over Temperature
3	8	FLD	Fold Back Protection
4	16	OVP	Over Voltage Protection
5	32	SO	Shut Off
6	64	OFF	Output Off
7	128	INT	Interlock
8	256	UVP	Under Voltage Protection
9	512	0	Not used
10	1024	INPO	Internal Input Overflow *
11	2048	INTO	Internal Overflow *
12	4096	ITMO	Internal Time Out *
13	8192	ICOM	Internal Comm Error *
14 to 15	N/A	0	Not used

Table 9-1: Bit Configuration of Questionable Registers

9.3.2 Status Register

The status register sets a bit when status changes (Refer to Table 9-2). The bit is cleared when the condition is removed.

Bit Number	Decimal Value	Bit Symbol	Description
0	1	CV	Set high if Constant Voltage Operation
1	2	CC	Set high if Constant Current Operation
2	4	NFL	No fault
3	8	TW	Trigger wait
4	16	AST	Auto Start Enabled
5	32	FBE	Foldback enable
6	64	LSC	List step complete
7	128	LOC	Local / Remote
8	256	UVP Ena	Under voltage Protect enabled
9	512	ILC Ena	Interlock Enabled
10	1024		
11	2048	FBC	Foldback CC mode enabled
12	4096	AVP	Remote Analog Voltage Programming mode
13	8192	ACP	Remote Analog Current Programming mode
14	16384	DWE	The list step is active (dwelling)
15	32768		Reserved

Table 9-2: Bit Configuration of Operation

9.4 Conditional, Enable and Event Registers

9.4.1 Conditional Registers.

The condition registers show a snapshot of the power supply state at the present time. Some faults or mode changes occur and clear quickly before the control computer can detect them. The change may be latched in EVENT REGISTERS so the computer can detect them even if they cleared quickly.

9.4.2 Event Registers.

Bits are sent to the Event register when a fault or mode change occurs. The bit remains set until the control computer reads the Event register or clears it. The control computer cannot tell if the fault or mode change occurred more than once since the last time the Event register was read.

9.4.3 Enable Register

The Status and Fault Enable registers are set by the user to enable SRQs in the event of changes in power supply status or fault.

9.5 Service Rrequest

A SRQ will be sent when the contents of at least one of the event registers changes from all zeroes to any bit(s) set. When SRQ occurs, power supply sends "!nn" message (nn-power supply address).

9.6 Standard Event Status Group

9.6.1 Register Functions

This group consists of an Event register and an Enable register that are programmed by COMMON commands. The Standard Event register latches events relating to interface communication status. It is a read-only register that is cleared when read. The Standard Event Enable register functions similarly to the Enable registers of the Operation and Questionable status groups.

9.6.2 Register Commands

The common *ESE command programs specific bits in the Standard Event Status Enable register. Because the power supply implements *PSC, the register is cleared at power on if *PSC = 1.

*ESR? reads the Standard Event Status Event register. Reading the register clears it.

Bit	Signal	Meaning
0	OPC	Operation complete
2	QYE	Query error
3	DDE	Device-dependent error
4	EXE	Execution
6	CME	Command error
7	PON	Power on

Table 9-3: Standard Event Status Group

Operation Complete

Set whenever the last command is completed and the software is ready to accept another command, or when query results are available.

Query Error

Set when a query is made for which no response is available.

Device Dependent Error

Set for device specific errors. These errors are entered in the System Error Queue and have error codes greater than 0. See Section 5 for error descriptions.

Execution Error

Set when a parameter exceeds its allowed range.

Command Error

Set for a syntax error.

Power On

Set once at power-up. The Status Byte ESR bit is not set.

9.6.3 Status Byte Register

This register summarizes the information from all other status groups as defined in the IEEE 488.2 Standard Digital Interface for Programmable Instrumentation standard. The register can be read either by a serial poll or by *STB?. Both methods return the same data, except for bit 6. Sending *STB? return MSS in bit 6, while polling returns RQS in bit 6. The *CLS command will clear the Status Byte.

Bit	Signal	Meaning
3	QUES	Questionable Status summary bit
4	MAV	Message Available summary bit
5	ESB	Event Status summary bit
6	MSS RQS	Master Status summary bit Request Service bit
7	OPER	Operation Status summary bit

Table. 9-4: Status Byte Register

Error Information Available

This bit is set when any error is entered in the System Error queue. It is read using the SYSTem:ERRor? Query.

Message Available

Indicates a message is available in the GPIB output queue. This bit is cleared then the GPIB output buffer is read.

Standard Event Status Register

This is a summary bit for the ESR. It is set when any of the ESR bits are set, and cleared when the ESR is read.

The RQS Bit

Whenever the power supply requests service, it sets the SRQ interrupt line true and latches RQS into bit 6 of the Status Byte register. When the controller services the interrupt, RQS is cleared inside the register and returned in bit position 6 of the response. The remaining bits of the Status Byte register are not disturbed.

The MSS Bit

This is a real-time (unlatched) summary of all Status Byte register bits that are enabled by the Service Request Enable register. MSS is set whenever the power supply has at least one or more reasons for requesting service. Sending *STB? reads the MSS in bit position 6 of the response. No bits of the Status Byte register are cleared by reading it.

9.6.4 Determining the Cause of a Service Interrupt

You can determine the reason for an SRQ by the following actions:
Use a serial poll or the *STB? query to determine which summary bits are active.
Read the corresponding Event register for each summary bit to determine which events caused the summary bit to be set. When an Event register is read, it is cleared. This also clears the corresponding summary bit.
The interrupt will recur until the specific condition that caused the event is removed. If this is not possible, the event may be disabled by programming the corresponding bit of the status group Enable register. A faster way to prevent the interrupt is to disable the service request by programming the appropriate bit of the Service Request Enable register.

9.6.5 Output Queue

The Output Queue is a first-in, first-out (FIFO) data register that stores power supply-to-controller messages until the controller reads them. Whenever the queue holds one or more bytes, it sets the MAV bit (4) of the Status Byte register. If too many unread error messages are accumulated in the queue, a system error message is generated. The Output Queue is cleared at power On and by *CLS.

9.6.6 Error Messages

System Error Messages are read back via the SYST:ERR? query. The error number is the value placed in the power supply error queue. SYST:ERR? returns the error number into a variable and combines the number and the error message into a string. Table 9-5 lists the system errors that are associated with SCPI syntax errors and interface problems. Information within the brackets is not part of the standard error message, but is included for clarification. When system errors occur, the Standard Event Status register records them as follows:

Bit Set	Error code	Error Type	Bit Set	Error code	Error type
5	-100 thru -199	Command	3	-300 thru -399	Device-dependent
4	-200 thru -299	Execution	2	-400 thru -499	Query

Table. 9-5: Standard Event Status Register Error Bits

The Status and Error Registers described in the previous section are only one of the status methods in the IEEE board. There is also a SCPI requirement for error messages that are in the form of:

<Error Number><Comma><Quote><Error Description:Supply Address><Quote>

The user sends the "SYST:ERR?" query to read the error message. The messages are stored in a first-in/first-out queue.
The SYST:ERR queue can buffer up to TEN error messages, although the tenth is replaced by the –350,"Queue Overflow" if an eleventh message is generated. After the queue overflow, only the first ten messages are stored and the later messages are lost.
The SYST:ERR queue is cleared by:
Reading the messages one at a time using "SYST:ERR?" until 0,"No error" is read, or
The *CLS (Clear Status) command.
If any message is in the SYST:ERR queue (except "No error"), then bit 2 of the Status Byte is set. A Service Request is generated if bit 2 is enabled.

Error Number	Error Description	Error Event
0	"No Error"	No Error Reported
-100	"Command Error"	Unit Receives Command With Unspecified Error.
-101	"Invalid Character"	A Character Was Received That Is Not: A-Z, A-Z, 0-9, ?, *, :, ;, Period, Space, CR, LF.
-104	"Data Type Error"	IEEE Receives Command Parameter With Wrong Type Of Data. Example: Receives Letter Where Number Expected.
-109	"Missing Parameter"	Valid Command Received But Not Enough Characters.
-131	"Invalid Suffix"	Unrecognized Units, Or Units Not Appropriate
-200	Execution Error	Generic. This is the generic syntax error for devices that can not detect more specific errors.
-222	"Data Out Of Range"	Attempt To Program Voltage, Current Or OVP Beyond Supply Limits.
-223	"Too Much Data"	Out Of Memory; Block, String, Or Expression Too Long
-241	"Hardware Missing"	When Operating In Multi Drop Mode, An Attempt Was Made To Address A Non-Existent Supply. (only for IEEE and LAN)
-284	"Program Currently Running"	Occur when the device was initiated by "INIT" command.
-286	"Data Load Empty"	Data doesn't saved in List or Wave cell
-350	"Queue Overflow"	Too Many SYST:ERR Messages Are Stored In This Queue And The Newest Messages Are Discarded
301	"PV Above OVP"	Attempt To Program Voltage Above OVP Setting.
302	"PV Below UVL"	Attempt To Program Voltage Below UVL Setting.
304	"OVP Below PV"	Attempt To Set OVP Below Voltage Setting.
305	"UVL Below Zero"	Attempt To Set UVL Above Voltage Setting.
306	"UVL Above PV"	Attempt To Set UVL Above Voltage Setting.
307	"On During Fault"	Attempt To Turn Supply Output ON When A Fault Exists.
320	"Under-Voltage Shutdown"	Under Voltage Shutdown Occurred
321	"AC Fault Shutdown"	Brown-Out Or Phase-Loss Shutdown Occurred
322	"Over-Temperature Shutdown"	Over-Temperature Shutdown Occurred
323	"Fold-Back Shutdown"	Fold-Back Shutdown Occurred
324	"Over-Voltage Shutdown"	Over Voltage Shutdown Occurred
325	"Analog Shut Off Shutdown"	Shut Off Occurred From Rear Panel
326	"Output-Off Shutdown"	Output-Off Occurred From Front Panel Button
327	"Interlock Open Shutdown"	Interlock Open Occurred From Rear Panel
329	"SLAD mode"	Cannot execute command in SLAD mode.
340	"Internal Message Fault"	General Non-Specified Internal Message Fault
341	"Input Overflow"	Receive Buffer over 500 chars
342	"Internal Overflow"	Serial Receive Buffer In IEEE Is Full Because Supply Sent Too Many Characters
343	"Internal Timeout"	IEEE Did Not Receive Response From Supply Before Timeout Period
344	"Internal Checksum"	IEEE Received Checksum Error, From Supply.
399	"Unknown Error"	No Known Error.
-400	"Query Error"	This Is The Generic Error For The Power Supply, Used Only When The Other Types Of Error Do Not Apply
-410	"Query INTERRUPTED"	Generated When A New Command Was Received Before It Could Finish The Query.

Table. 9-6: Error Table

CHAPTER 10: ISOLATED ANALOG PROGRAMMING OPTION

10.1 Introduction

Isolated Analog Programming is an internal option card for analog programming of the Z+ Power Supply series. The option is factory installed and cannot be obtained with GPIB (IEEE) Interface. Output Voltage and Current Limit can be programmed and readback through optically isolated signals which are isolated from all other ground references in the power supply.
There are two types of Isolated Analog programming cards:

1. 0-5V/0-10V option (PN: IS510): Using 0-5V or 0-10V signals for programming and readback.
2. 4-20mA option (PN: IS420): Using current signals for programming and readback.

10.2 Specifications

10.2.1 0-5V/0-10V Option (PN: IS510)

Programming Inputs	Output voltage programming accuracy	%	+/-1
	Output current programming accuracy	%	+/-1
	Output voltage programming temperature coefficient	PPM/ C	+/-100
	Output current programming temperature coefficient	PPM/ C	+/-100
	Input impedance	Ohm	1M
	Absolute maximum voltage	Vdc	0-15
	Max. voltage between program inputs and supply outputs	Vdc	600
Monitoring Outputs	Output voltage monitoring accuracy	%	+/-1.5
	Output current monitoring accuracy	%	+/-1.5
	Output Impedance (see note)	Ohm	100
	Max. voltage between monitoring outputs and supply outputs	Vdc	600

NOTE:

Use 100Kohm minimum input impedance for the monitoring circuits to minimize the readback error.

10.2.2 4-20mA Option (PN: IS420)

Programming Inputs	Output voltage programming accuracy	%	+/-1
	Output current programming accuracy	%	+/-1
	Output voltage programming temperature coefficient	PPM/ C	+/-200
	Output current programming temperature coefficient	PPM/ C	+/-200
	Input impedance	Ohm	50
	Absolute maximum input current	Vdc	0-30
	Max. voltage between program inputs and supply outputs	Vdc	600
Monitoring Outputs	Output voltage monitoring accuracy	%	+/-1.5
	Output current monitoring accuracy	%	+/-1.5
	Maximum load impedance	Ohm	500
	Max. voltage between monitoring outputs and supply outputs	Vdc	600

10.3 Isolated Programming & Monitoring Connector

Refer to Table 8-1 for detailed description of the Rear Panel Isolated Programming & Monitoring connector. To provide the lowest noise performance, it is recommended to use shielded-twisted pair wiring.
Refer to Fig.8-1 for description of the connector.
Isolated programming plug P/N: MC1.5/8-ST-3.81, Phoenix.

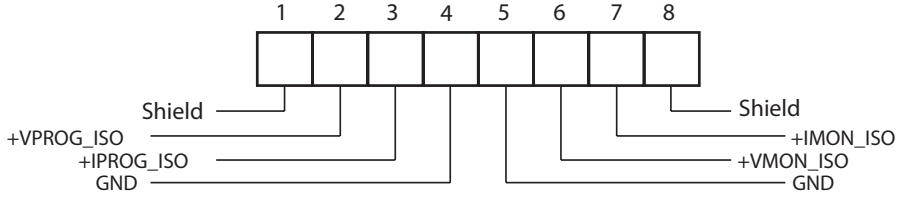


Fig.8-1: Isolated Programming & Monitoring connector

Terminal	Signal name	Function	Range 0-5/0-10V IS510 option	Range 4-20mA IS420 option
1	SHLD	Shield, connected internally to chassis of the supply.	Chassis ground	
2	+VPROG_ISO	Output voltage programming input	0-5/0-10V	4-20mA
3	+IPROG_ISO	Output current programming input	0-5/0-10V	4-20mA
4	GND	Ground for programming signals.	Ground	Ground
5	GND	Ground for programming signals.	Ground	Ground
6	+VMON_ISO	Output voltage monitoring output	0-5/0-10V	4-20mA
7	+IMON_ISO	Output current monitoring output	0-5/0-10V	4-20mA
8	SHLD	Shield, connected internally to chassis of the supply.	Chassis ground	

Table 10-1: Detailed description of the Rear Panel Isolated Programming & Monitoring connector.

CAUTION:

When the Isolated Analog Option is installed, do not apply any signals to the non-isolated VPGM and IPGM (J1-6 and J1-5) pins. All other J1 features may be used normally. Refer to Section 4.3.1 for a description of J1 features.

10.4 Setup and Operating Instructions

CAUTION:

To prevent damage to the unit, do not program the output voltage and current to higher than the power supply rating.

10.4.1 Setting Up Power Supply for 0-5/0-10V Isolated Programming and Monitoring

Perform the following procedure to configure the power supply:

1. Turn the power supply AC power switch to Off.
2. Short pins J1-1 to J1-7.
3. Press MENU button. MENU (GREEN) LED illuminates. "SEt" message appears on Voltage display.
4. Press Voltage Encoder. "UOLt" message appears on Voltage Display and "CUrr" appears on the current display.
5. Press Voltage Encoder to select programming of the Output Voltage, or press Current Encoder to select programming of the Output Current.
6. The selected function appears on the Voltage display. Parameter "F.PAn" or "E.UOL" or "E.rES" appears on the Current display.
7. Rotate and press the Current Encoder to select "E.UOL".
10. "UOLt" message appears on Voltage Display and "CUrr" appears on the Current display.
11. Rotate Current Encoder until "rAnG" appears on display. Press on the relevant Encoder.
12. "rAnG" appears on Voltage display and "5" (5V) or "10" (10V) appears on Current display.
13. Rotate and press the Current Encoder to select the desired programming Voltage range.
14. Press MENU button twice to return display to it's previous state. MENU LED turns OFF
15. Connect the programming sources to the mating plug of the Isolated Programming connector. Observe for correct polarity of the voltage source.
16. Set the programming sources to the desired levels and turn the power supply ON.

NOTE:

J1-1 and J1-7 must be shorted together with a jumper.

10.4.2 Setting Up Power Supply for 4-20mA Isolated Programming and Monitoring

The set up procedure of 4-20mA Isolated Programming and Monitoring is the same as section 8.4.1 expet "rAnG" setting. "rAnG" setting must be set to "10" (10V).

CAUTION:

To prevent damage to the unit, do not program the output voltage and current to higher than the power supply rating.

CHAPTER 11: MAINTENANCE

11.1 Introduction

This chapter provides information about maintenance, calibration and troubleshooting.

11.2 Units Under Warranty

Units requiring repair during the warranty period should be returned to a TDK Lambda authorized service facility. Refer to the address listings on the back cover of this manual. Unauthorized repairs performed by other than the authorized service facilities may void the warranty.

11.3 Periodic Maintenance

No routine maintenance of the power supply is required except for periodic cleaning. To clean, disconnect the unit from the AC supply and allow 30sec. for discharging internal voltage. The front panel and the metal surfaces should be cleaned using a mild solution of detergent and water. The solution should be applied onto a soft cloth, and not directly to the surface of the unit. Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. Use low pressure compressed air to blow dust from the unit.

11.4 Adjustments and Calibration

No internal adjustment or calibration is required. There is NO REASON to open the power supply cover.

11.5 Parts Replacement and Repairs

As repairs are made only by the manufacturer or by authorized service facilities, no parts replacement information is provided in the manual. In case of failure, unusual or erratic operation of the unit, contact the TDK Lambda sales or service facility nearest you. Please refer to the TDK Lambda sales offices address listings on the back cover of this user manual.

11.6 Troubleshooting

If the power supply appears to be operating improperly, use the troubleshooting guide to determine whether the power supply, load or external control circuits are the cause.
Configure the power supply for basic front panel operation and perform the tests listed in Section 3.8 to determine whether the problem can be found with the power supply.
Table 11-1 provides the basic checks that can be performed to diagnose problems, and references to relevant sections of this manual for further information.

SYMPTOM	CHECK	ACTION	REF.
No output. All displays and indicators are blank.	Is the AC power cord defective?	Check continuity, replace if necessary.	3.7
	Is the AC input voltage within range?	Check input AC voltage. Connect to appropriate voltage source.	3.6 3.7
Output is present momentarily but shuts off quickly. The display indicates "AC".	Does the AC source voltage sag when load is applied?	Check input AC voltage. Connect to appropriate voltage source.	3.6
Output is present momentarily but shuts off quickly. the display indicates "OUP".	Is the power supply configured to Remote sense?	Check if the positive or negative load wire is loose.	3.9.6 3.9.8
Output voltage will not adjust. Front panel CC LED is on.	Is the unit in constant current mode?	Check current limit setting and load current.	5.2.1 5.2.2
Output voltage will not adjust. Front panel CV LED is on.	Check if output voltage is adjusted above OVP setting or below UVL setting.	Set OVP or UVL not to limit the output.	5.3.2 5.3.3
Output current will not adjust. Front panel CV LED is on.	Is the unit in constant voltage mode?	Check current limit and voltage settings.	5.2
Large ripple present in output.	Is the power supply in Remote sense? Is the voltage drop on the load wire high?	Check load and sense wire connections for noise and impedance effects. Minimize the drop on the load wires.	3.9.4 3.9.8
No output. Display indicates "OUP"	Over Voltage Protection circuit is tripped.	Turn off the AC power switch. Check load connections. If analog programming is used, check if the OVP is set lower than the output.	5.3.2
No output. Front panel ALARM LED is blinking.	Display indicates "EnA"	Check rear panel J3 Interlock Function.	5.7.2
	Display indicates "SD"	Check rear panel J3 Output Shut Off connection.	5.7.1
	Display indicates "OTP"	Check if air intake or exhaust are blocked. Check if the unit is installed adjacent to heat generating equipment.	5.3.6
	Display indicates "Fb"	Check Foldback setting and load current.	5.3.4
Poor Load regulation Front panel CV LED is on.	Are sensing wires connected properly?	Connect the sense wires according to User's Manual instructions.	3.9.8
The front panel controls are nonfunctional.	Is the power supply in Local-Lockout mode?	Turn Off the AC power and wait until the display turns off. Turn on the AC power and press front panel REM/LOC button.	7.2.6

Table 11-1: Maintenance

11.7 Fuse Rating

There are no user replaceable fuses in the power supply. Internal fuses are sized for fault protection and if a fuse was opened it will indicate that service is required. Fuse replacement should be made by qualified technical personnel. Refer to Table 11-2 for a listing of the fuses.

Input AC fuse F101	250VAC, 10A, Fast acting

Table 11-2: Internal Fuse

11.1 Einleitung

Dieses Kapitel liefert Informationen über Wartung, Kalibrierung und Fehlersuche.

11.2 Reparaturen während der Garantie

Sollte ein Gerät innerhalb der Garantiezeit ausfallen, so dürfen Reparaturen nur durch Lambda oder autorisierte Servicestellen durchgeführt werden. Die Adressen finden Sie am Ende dieses Handbuches. Eingriffe in die Geräte durch nicht autorisierte Stellen führen zum Verlust des Garantieanspruches.

11.3 Periodische Wartung

Die Geräte sind wartungsfrei. Wir empfehlen jedoch die regelmäßige Reinigung. Trennen Sie die Einheit vom Versorgungsnetz und warten Sie 30 Sekunden um sicherzugehen, dass sich interne Spannungen abgebaut haben. Die Frontabdeckung und die Metalloberflächen sollten mit einer milden Lösung aus Reinigungsmitteln und Wasser gesäubert werden. Die Lösung sollte auf ein weiches Tuch aufgetragen werden, und nicht direkt auf Oberfläche der Geräte. Benutzen Sie keine Reinigungsmittel, die aromatische Kohlenwasserstoffe oder gechlorte Lösungsmittel enthalten. Benutzen Sie schwach komprimierte Pressluft, um das Gerät von Staub zu befreien.

11.4 Einstellungen und Kalibrierung

Interne Einstellung oder Kalibrierung ist nicht nötig. Es gibt keinen Grund, die Stromversorgung zu öffnen.

11.5 Bauteilewechsel und Reparaturen

Da Reparaturen nur durch den Hersteller oder autorisierte Servicestellen durchgeführt werden dürfen, enthält das Handbuch keine Schaltpläne. Im Falle eines Defektes oder ungewöhnlichem Verhalten des Gerätes, setzen Sie sich bitte mit der nächstgelegenen Lambda Niederlassung in Verbindung. Die Adressen finden Sie am Ende dieses Handbuches.

11.6 Fehlersuche

Sollte die Stromversorgung nicht wie erwartet funktionieren, kann Ihnen die nachfolgende Tabelle helfen, herauszufinden, ob die Stromversorgung, die Last oder eine externe Steuerung die Ursache dafür ist.
Stellen Sie das Netzgerät so ein, dass es mit den Reglern und Tasten am Frontpanel bedient werden kann. Führen Sie dann die Tests aus Abschnitt 3.8 durch, um festzustellen, ob das Problem durch das Netzgerät verursacht wird.
Tabelle 11-2 führt Sie Schritt für Schritt durch die Prüfungen, die durchgeführt werden sollten, um die Fehlerursache zu ermitteln und gibt Ihnen Hinweise auf Abschnitte dieses Handbuches, in denen Sie weiterführende Informationen finden können.

11.7 Rungswerte

Im Gerät befinden sich keine Sicherungen, die durch den Anwender ersetzt werden können.
Sicherungen sind als Schutz eingebaut, falls im Gerät Fehler auftreten sollten. Sollte eine Sicherung auslösen, so muss das Gerät zur Reparatur gegeben werden. Sicherungen dürfen ausschließlich von dafür geschultem, technischen Personal ausgewechselt werden. In Tabelle 11-1 sind die Sicherungswerte aufgelistet.

Eingangssicherung F101	250V, 10A, Fast-Acting

Tabelle 11-1: Interne Sicherungen

Symptom	Prüfung	Tätigkeit	Ref.
Keine Ausgangsspannung. Displays und Anzeigen sind dunkel.	Ist das Netzkabel defekt?	Falls erforderlich, Netzkabel ersetzen.	3.7
	Ist die Netzspannung innerhalb des Eingangsbereiches?	Netzspannung prüfen, Gerät an passende Versorgungsspannung anschließen.	3.6 3.7
Ausgangsspannung liegt kurzfristig an, schaltet aber sofort wieder ab. Das Display zeigt "AC" an.	Bricht die Netzspannung zusammen, wenn am Ausgang die Last angeschlossen wird?	Netzspannung prüfen, Gerät an passende Versorgungsspannung anschließen.	3.6
Ausgangsspannung liegt kurzfristig an, schaltet aber sofort wieder ab. Das Display zeigt "OUP" an.	Werden die Sense Anschlüsse benutzt?	Prüfen, ob die Lastleitungen ordnungsgemäß angeschlossen sind.	3.9.6 3.9.8
Ausgangsspannung kann nicht eingestellt werden. CC LED am Frontpanel leuchtet.	Arbeitet das Gerät im Konstantstrom-Modus?	Strombegrenzungseinstellungen und Laststrom prüfen.	5.2.1 5.2.2
Ausgangsspannung kann nicht eingestellt werden. CV LED am Frontpanel leuchtet.	Prüfen, ob die Einstellung für die Ausgangsspannung über der OVP oder unter der UVL Einstellung liegt.	OVP oder UVL so einstellen, dass keine Einschränkung im gewünschten Bereich erfolgt.	5.3.2 5.3.3
Ausgangsstrom kann nicht eingestellt werden. CV LED am Frontpanel leuchtet.	Arbeitet das Gerät im Konstantspannungs-Modus?	Strombegrenzung und Spannungseinstellungen prüfen.	5.2
Die Ausgangsspannung hat eine hohe Restwelligkeit.	Werden die Sense Anschlüsse benutzt? Ist der Spannungsfall über die Lastleitungen sehr hoch?	Last- und Senseleitungen auf gute Verbindung prüfen. Spannungsfall an den Lastleitungen verringern.	3.9.4 3.9.8
Keine Ausgangsspannung. Am Display wird "OUP" angezeigt.	Der Überspannungsschutz ist aktiv.	Gerät mit dem Netzschalter abschalten. Lastverbindungen prüfen. Falls analoge Programmierung verwendet wird ist zu prüfen, ob die Einstellungen für den OVP niedriger als die Ausgangsspannung eingestellt ist.	5.3.2
Keine Ausgangsspannung. ALARM LED am Frontpanel blinkt.	Das Display zeigt "EnA" an.	An der Rückseite den ENABLE Anschluss an J3 prüfen. SW1 ordnungsgemäß einstellen.	5.7.2
	Das Display zeigt "SD" an.	An der Rückseite den Shut Off Anschluss an J3 prüfen.	5.7.1
	Das Display zeigt "OTP" an.	Prüfen, ob die Lüftungsöffnungen verschlossen sind oder ob sich Heizquellen in der Nähe befinden.	5.3.6
	Das Display zeigt "Fb" an.	Foldback Einstellung und Laststrom prüfen.	5.3.4
Schlechte Lastregelung. CV LED am Frontpanel leuchtet.	Sind die Sense-Leitungen ordnugsgemäß angeschlossen?	Sense-Leitungen laut Anweisungen im Handbuch anschließen.	3.9.8
Bedienelemente am Frontpanel sind ausser Funktion.	Wird das Gerät im Local-Lockout Modus betrieben?	Gerät ausschalten und warten bis die Anzeigen erloschen sind. Gerät wieder einschalten und REM/LOC Taste am Frontpanel betätigen.	7.2.6

Tabelle 11-2: Fehlersuche

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